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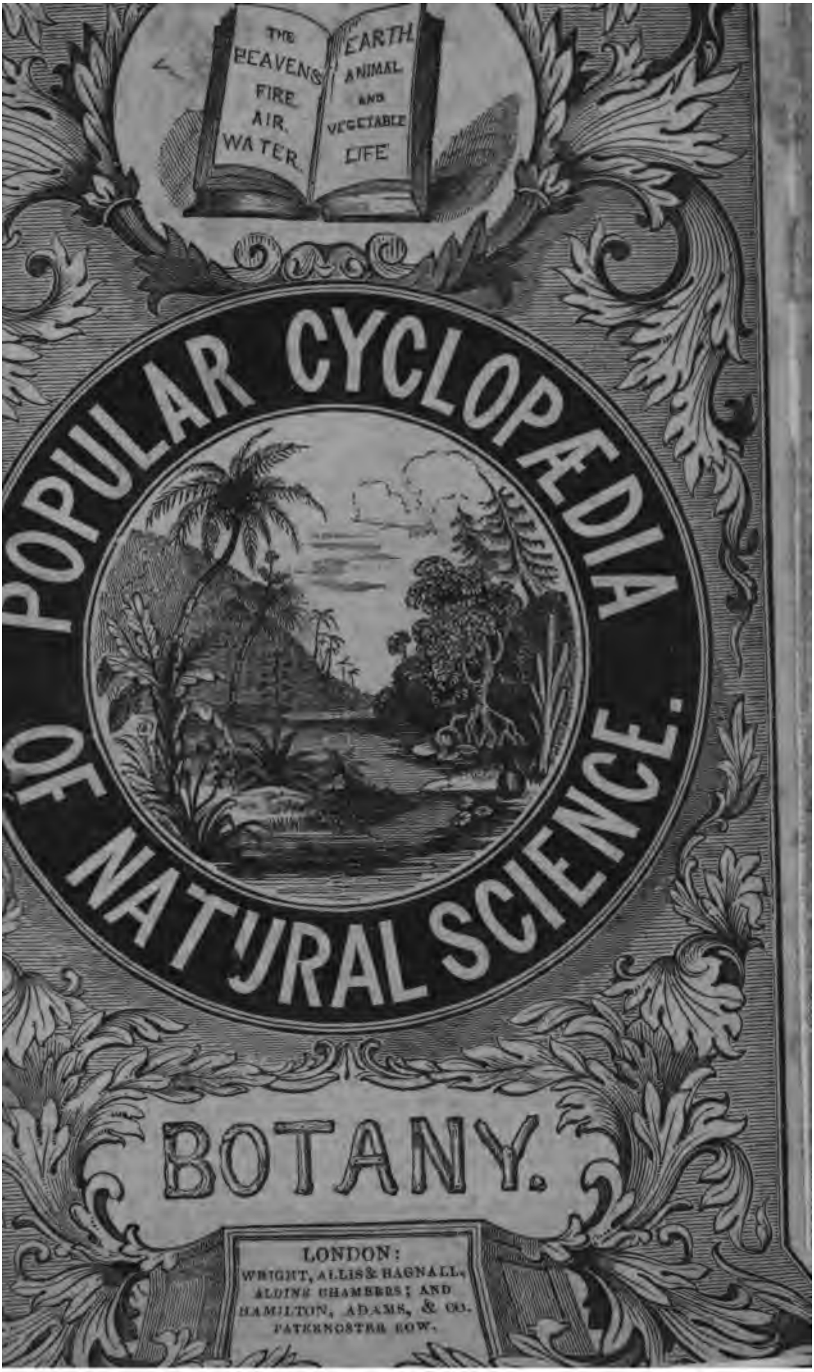

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Thus of the Willow, 71 species have been stated by one authority to exist in Britain, whilst another reduces them to 29. The genus Rubus or common Bramble has been thought to contain 21 British species, which are probably reducible to 6 or 8. These details are here introduced, for the purpose of putting the young Botanist on his guard, against the tendency to multiply species, which is now prevalent among superficial writers, and which is still further encouraged by Gardeners, who give new specific names to such varieties as those just alluded to, and even to *hybrids* between these (§ 454.).

477. When the Botanist has satisfied himself regarding the species which he has collected, his next step is to combine those amongst which he finds the greatest resemblance, into *genera*. Now in this process he must not be influenced by similarity in their general external aspect; for this will often conceal great differences in their most important organs. There are certain parts which furnish *essential* characters, without similarity in which it would be wrong to associate species, however alike in other respects, in the same genus; and, on the other hand, there are parts so susceptible of variation, that the differences between them must be very striking indeed, to warrant the plants being arranged under different genera, when they agree in what have been termed the essential characters. Thus, for instance, the general outline of the leaf has been stated to be often subject to great variety, in accordance with the degree in which the space between the veins is filled up with fleshy parenchyma (§ 234,5); and in most cases, a difference in the outline of the leaves of two plants, the distribution of the veins remaining the same, would not alone serve to cause two plants exhibiting it to rank even as distinct species. But any considerable alteration of the veining would be held sufficient for such a separation; though the two plants, if agreeing in the structure of their organs of fructification, would still be placed in the same genus. On the other hand, a marked and constant difference in the organs of fructification would be rightly held sufficient to place the two species in different genera, even though the form and veining of the leaves might be precisely the same.

On the relative value of the characters furnished by the different organs more will hereafter be stated.

478. Even when thus grouped together into genera, however, the number of objects, which the Botanist has to study, remains by far too great for convenience; and he next forms his genera into *orders*, and combines these orders into *classes*, according to their respective correspondence and difference in certain characters of a still more general nature. Now in this process he may follow two very different plans; and upon these are founded the two systems of classification which are now in vogue. The one of these is termed the Linnæan System, after its founder; or the Artificial System, from its character: the other is termed the Natural System. In the Linnæan System, a small number of characters,—chiefly the number of stamens and pistils—is taken as the standard; and the whole Vegetable Kingdom is distributed under classes and orders, according to the correspondences and differences among the several genera in these respects,—no regard whatever being had to any other characters. In the Natural System, *all* the characters of the genera are studied; and those are united into orders, which present the greatest correspondence in the characters that are regarded as of the most importance: on the same principle, the orders are united into classes. If the former plan be followed, genera most widely differing in their structure and physiological characters are often brought together, and others which are nearly allied are frequently separated to a great extent; so that in fact, it is very common to find, that nothing can be stated of all the plants included in a Linnæan order, except that they have a similar number of stamens and pistils. On the other hand, in the Natural System, the number of characters, in which there is a general agreement among all the plants of a particular order, is so great that, to say that the plant belongs to a certain order, is at once to give the greater part of its description. This is the case also in the highest or most general groups. For instance, to say that a particular species is an Exogen, is at once to make known the structure of its stem and the mode of its increase,—to express the important fact that it has two cotyledons or seed-leaves,—to render it most

probable hat the arrangement of the veins in its leaves is reticulated rather than parallel,—and to intimate that the parts of its flowers are likely to be arranged in fives or fours, rather than in threes.

479. There is a point of agreement among the plants brought together in Natural orders, which is of the greatest practical importance. This is, that those which agree in structure almost invariably correspond in *properties* also. For instance, the whole of the Papaveraceæ or Poppy tribe possess narcotic properties; all the Ranunculaceæ or Crowfoot tribe are acrid; whilst all the Malvaceæ or Mallow tribe are destitute of unwholesome properties. Thus, when a plant is recognized as a member of a particular Natural Order, an almost certain account may be given of its properties,—whether it is likely to be injurious or wholesome, to furnish valuable medicines, or important articles of food. It must be remembered, however, that the peculiar properties of the plant do not pervade every portion of it; and that it may hence be possible to obtain wholesome nutriment, even from members of orders most distinguished for their deleterious properties. Thus the Potatoe belongs to the order Solaneæ, which contains the Deadly Night-shade, Henbane, and other poisonous plants; but the edible part of it, which is a deposition of starch for an express purpose (§ 337), is free, or nearly so, from the narcotic properties which exist in the stems and leaves. Indeed, as a general rule, such depositions of starch may supply wholesome food in any order, more especially if care be taken to free them from any juices they may contain; thus the Cassava, which furnishes one of the most important articles of food to the inhabitants of many tropical countries, is obtained from a plant of the order Euphorbiaceæ or Spurge tribe, which is distinguished for its very acrid qualities: and these are shared by the juice expressed from the meal after it has been ground.

480. The Linnæan system, however, is not without its advantages for particular purposes. To a person commencing by himself the study of Systematic Botany, desirous of making himself acquainted with the names and characters of the plants he may

meet with in his walks, and not ambitious of extending his studies to the higher parts of the science, the Linnæan system, when applied with the aid of books, possesses facilities which are (at present at least) greatly superior to those afforded by the other, and which are well calculated to encourage a learner. To count the number of stamens and pistils is generally a very easy process; this at once establishes the class and order; and nothing then remains, but to determine the genus and species, which (among the comparatively small number found in Britain) a little practice in the examination of characters will enable any intelligent person to do, with the aid of books in which these are laid down. The habit thus gained of discriminating characters, and of applying terms, is a most valuable preparation for the study of the Natural System when opportunity presents itself. It must be constantly borne in mind, however, that the utmost use that can be made of the Linnæan system, consists in the assistance it affords in the discovery of the *name* of an unknown plant; and, until this has been made out, the previous determination of its class and order gives no indication of its general structure and properties (not even making it apparent whether it is an Endogen or an Exogen, a Dicotyledon or a Monocotyledon), since under the same head are grouped genera of the most opposite character. It may be said that it serves as a sort of Alphabetical index to a book, enabling the reader to turn to any part of it he wishes, by looking out the subject in the order of its first letters, but giving no idea whatever of the general scope of the book, nor of the mode in which its subjects are arranged.

481. The Linnæan System is liable to many imperfections and difficulties in its application, even in the limited circle of British Plants; for example, the number of pistils is liable to be altered in any species by the more or less complete adhesion of the carpels; and that of the stamens may also vary in the different species of the same genus, and even among the different individuals of the same species, or even (in some instances) among the different flowers of the same stem. The adoption of characters thus liable to vary cannot, therefore, but sometimes lead to confusion. For

instance, of the genus Polygonum, of which the several British species are known by the names of Bistort, Buck-wheat, Persicaria, &c., one has always, and two others have occasionally, eight stamens; whilst in the rest the number varies from five to ten. As eight seems to be the most regular number, the plant is placed in the class Octandria: and although its styles are sometimes only two in number, it is placed in the order Trigynia, because they are more commonly triple. Now if a student meet with a specimen which has five, six, or ten stamens, he will vainly search for its character among the genera of the Linnæan class to which it would seem to belong; and unless he happen to consult a book which makes special mention of the genus in these several classes, he will be altogether at fault. Suppose that some more knowing Botanist tells him that his plant is a Polygonum, he will again turn to his book, wondering how he could have overlooked it; but he will find the genus in the class Octandria, in spite of the different number of stamens in the specimen before him: and he will then learn that it is placed in the genus Polygonum on account of its strong general resemblance to other Polygonums, in spite of its differing from them in characters which are ordinarily considered as sufficient to establish classes and orders. Again, the greater part of the species of the genus *Rhamnus* (Buckthorn) possess both stamens and pistils in the same flower; but the species most commonly known in this country on account of its purgative properties is Diœcious, the stameniferous flowers being on one plant, and the pistiliferous on another. (§ 435). The students who met with it, therefore, would seek for it in the class Diœcia, where he would be disappointed as before; since, as in most species the flowers are complete, it is placed in the class and order to which the number of its stamens and pistils would refer it.

482. Such exceptional cases occur much more frequently than is commonly supposed. It has been proved that, in fourteen divisions of the Linnæan system, including 173 British genera, there are no less than 43 exceptions,—one-quarter of the whole; and that out of 274 genera of North America, belonging to eighteen Linnæan sections, there are 78 exceptions,—rather more than a quarter.

These facts are important, both as preparing the student to meet with such difficulties, even in the study of the Linnæan system, which is generally considered so easy of application; and also as showing the imperfection of the system itself, which is of no value whatever, beyond the temporary purpose of facilitating the early studies of the Botanical Student. In well-arranged descriptions of British Plants (such as Hooker's British Flora, which may be strongly recommended for this purpose) the most perplexing of these cases are noticed, in such a manner as to prevent the loss of time and labour, in vain attempts at discovering genera in wrong classes, or species in wrong genera.

483. Entertaining, as the writer does, from some experience in the matter, the foregoing opinion of the advantages of the Linnæan System for a beginner, it is desirable here to give an outline of the principles upon which its divisions are founded, which may serve as an introduction to the regular systematic treatises on the subject. The Phanerogamia or Flowering Plants are distributed under twenty-three Classes, all of which are characterized either by the *number* or particular *arrangement* of the stamens. In the first twelve of these, *number* alone is regarded. Their names are formed by the combination of the Greek numeral expressing the required number, with the termination *andria*, which has reference to the supposed *male* office of the stamens in the process of fertilization. These classes, therefore, stand simply as follows.

Class I.	Monandria,	One Stamen.
II.	Diandria,	Two Stamens
III.	Triandria,	Three Stamens
IV.	Tetrandria,	Four Stamens
V.	Pentandria,	Five Stamens
VI.	Hexandria,	Six Stamens
VII.	Heptandria,	Seven Stamens
VIII.	Octandria,	Eight Stamens
IX.	Enneandria,	Nine Stamens
X.	Decandria,	Ten Stamens
XI.	Dodecandria,	Twelve to Nineteen Stamens
XII.	Icosandria,	Twenty or more Stamens.

To the last mentioned class, however, another character belongs; for in the next class, POLYANDRIA, the number of stamens is also twenty or more. They are distinguished by the mode of insertion of the stamens; these appearing to arise from the calyx in the former, and from the disk or receptacle in the latter. This distinction, which will be hereafter shown to be important in the Natural System, will be at once understood by comparing a true Rose, Plum, Cherry, or Pear blossom, with a Christmas Rose, an Anemone, or a Pæony; when the calyx and corolla of the former are pulled off, they carry the stamens with them; but they may be entirely removed from the latter, leaving the stamens attached to the disk. These two classes will, therefore, stand as follows:—

Class XII. ICOSANDRIA, Stamens Twenty or more, inserted into the calyx.

Class XIII. POLYANDRIA, Stamens Twenty or more, inserted into the receptacle.

The next two classes are characterized by peculiarities in the proportional length of the stamens, as well as in their number. Those which are *longer* than the rest are said to be *in power;* and the termination *dynamia* is applied to the number of these, in order to designate their peculiarity.

Class XIV. DIDYNAMIA, Four Stamens, two longer than the others.

Class XV. TETRADYNAMIA, Six Stamens, four longer than the others.

The three following classes are characterized by the more or less complete union of the filaments of the stamens into bundles, or *brotherhoods;* on account of which the termination *adelphia* is applied to the number of such bundles.

Class XVI. MONADELPHIA, Stamens united into a single bundle, forming a tube which surrounds the style.

Class XVII. DIADELPHIA, Stamens united into two bundles.

Class XVIII. POLYADELPHIA, Stamens united into several bundles.

In the next class, it is the anthers which form the tube; and the name applied to it signifies a *growth together.* In the succeeding class, the stamens and the pistil grow together; and the name *gyn-andria* refers to this union of the male organs with the female, the latter being designated by the first syllable, which will presently be seen to be much employed in the description of the orders.

Class XIX. SYNGENESIA, Stamens united by their anthers into a tube.

Class XX. GENANDRIA, Stamens and Pistils grown together.

The three remaining classes are characterized by the separation of the stameniferous and pistilliferous flowers; the import of the names of the first two has been already explained. (§ 435.)

Class XXI. MONŒCIA, Stamens and Pistils in separate flowers, but both growing on the same plant.

Class XXII. DIŒCIA, Stamens and Pistils not only in two separate flowers, but these flowers situated on two different plants.

Class XXIII. POLYGAMIA, Stamens and Pistils separated in some flowers, united in others, either on the same plant or on two or three different ones.

This last class is now united, by the common consent of Botanists who adopt the Linnæan System, with that of SYNGENESIA; since all its stameniferous flowers are marked by the adhesion of the anthers; and the great variety of the distribution of the sexual organs among the different flowers renders it undesirable to employ *that* as a character. Including the POLYGAMIA, then, the class Syngenesia exactly corresponds with that which will be described in the Natural System as the Order COMPOSITÆ, including those plants in which the flowers are crowded together in *heads*, as in the Sun-flower, Dandelion, &c.

484. The Orders, or subdivisions of the classes, are generally founded upon the number of the styles, or (if these be not present) of the stigmas; or upon certain peculiarities of the seed-vessel. In the first thirteen classes, the number alone is regarded; and the orders are designated, as before, by the Greek numerals, with the termination *gynia*, which refers to the supposed female character of the pistil.

Order 1.	*Monogynia*,	One Style
2.	*Digynia*,	Two Styles
3.	*Trigynia*,	Three Styles
4.	*Tetragynia*,	Four Styles
5.	*Pentagynia*,	Five Styles
6.	*Hexagynia*,	Six Styles
7.	*Heptagynia*,	Seven Styles
8.	*Octogynia*,	Eight Styles
9.	*Enneagynia*,	Nine Styles
10.	*Decagynia*,	Ten Styles
11.	*Dodecagynia*,	Twelve Styles
12.	*Polygynia*,	More than Twelve Styles.

It will be evident, from the description of the structure of the pistil formerly given (§ 434.), that the number of styles affords no indication of the character of the ovarium. Thus, the ovarium may be formed of many carpels, the divisions between which remain as distinct partitions, whilst the styles and stigmata of all these may have coalesced into one pillar; so that we may have a single style with a many-celled seed-vessel. On the other hand, the walls of the carpels may form but incomplete partitions, so that the cavity of the ovarium is undivided (Fig. 50.); whilst the styles and stigmata may be numerous. It will hereafter be shown that the structure of the ovarium itself is a much less variable character than the number of styles, which is liable to alteration in many species (like that of the stamens) through the adhesion or the non-development of some of them. In the class DIDYNAMIA, the characters of the orders are drawn from the structure of the seed-vessel. The first, *Gymnospermia*, or naked-seeded, includes those in which the ovary has four carpels, each enclosing a single seed; and this, when mature, fills up the cavity in such a manner, that the wall of the seed-vessel appears like an outer coat to the seeds, which thus do not seem to have any other envelope. We shall hereafter find that the only *true* naked-seeded plants are the Coniferæ or Pine tribe, and its allies, in which the seeds never are enclosed in a seed-vessel. The second Order, *Angiospermæ*, includes those Didynamia which have a distinct seed-capsule, usually two-celled, each cavity containing many seeds. In the next class, TETRADYNAMIA, there are also two orders, distinguished by the form of their pod-like seed-vessel;—the first, *Siliquosæ*, having a long-pod;—the second, *Siliculosæ*, a short one. The Orders of the classes MONADELPHIA, DIADELPHIA, POLYADELPHIA, depend upon the number of their stamens; and they have the same names as the thirteen first classes,—the number of stamens, however, being never less than five. The subdivision of the class SYNGENESIA (as now understood) is rather complex; and, as it is nearly the same in the Natural System, it will be better explained under the Order Compositæ. The orders of the classes GYNANDRIA, MONŒCIA, and DIŒCIA, are distinguished by the number of stamens, and are consequently *Monandria*, *Pentandria*, &c.

485. There are many of these orders which form groups truly natural; that is, which consist of genera having a large number of points of agreement with each other, independently of the characters on which the subdivision is founded. For example one portion of the class PENTANDRIA, order *Monogynia*, corresponds with the Natural Order *Umbelliferæ* (including the Parsley, Carrot, Hemlock, Parsnep, &c.); the Class TRIANDRIA, order *Digynia*, very nearly corresponds with the natural group of Grasses, all these having three stamens and two styles, which combination is not found in any other plants. The DIDYNAMIA *Gymnospermia* again, are the same with the Natural Order *Labiatæ*, to which belong the various kinds of Mint, Thyme, Dead Nettle, &c; and the class TETRADYNAMIA corresponds with the natural Order *Cruciferæ*, to which belong the Mustard, Cress, Cabbage, Turnip, Stock, Wall-flower, &c. From the predominance of the number *three* and its multiples in the parts of the flower of Endogens, we find most of this group included in the classes Triandria, Hexandria, and Nonandria; whilst the prevalence of the numbers four and five among Exogens, causes the classes Tetrandria and Pentandria, Octandria and Decandria, with Icosandria and Polyandria, to contain a very large proportion of that division. But the Linnæan system often brings together Exogens and

Endogens into close contact; besides breaking up the natural alliances of each, so as to scatter widely apart the members of groups nearly united. Examples of this will be hereafter given.

486. The Natural System, on the other hand, aims to present an harmonious and consistent view of the Vegetable Kingdom, by associating into Orders those genera which agree in the most numerous and important characters, and which differ from others in the same. A table of the characters of these Orders would therefore resemble the Table of Contents of a well-arranged book; giving at one glance to a person at all acquainted with the subject, an idea of the mode in which it is treated by the author, and of the relations which the several divisions of it had in his mind; and enabling a person who is entering upon the study of it, to do so with the knowledge that he is not gleaning at random, as if he were reading through a Dictionary, but that every acquisition he makes of an individual part is something toward an acquaintance with the plan of the whole. One more illustration may set this matter in a still clearer light. The reader may be requested to consider this series of Treatises as completed according to the original plan; and as consisting of a number of Volumes, each devoted to some particular Science, but all having a certain degree of connexion with each other. Each Volume consists of a series of Chapters, in which the subdivisions of these Sciences are respectively treated of, and among which there is a still closer degree of connexion. Every chapter, again, is made up of a number of paragraphs, each intended to contain one or more important facts, the knowledge of which is in itself useful, but which can only be fully understood when read continuously with the preceding and following paragraphs. We shall further suppose that the subject of every paragraph could be concisely expressed by a single word. Now we will imagine these paragraphs, all printed on separate slips of paper, with their appropriate titles, were given to a man of science with a request that he would arrange them for publication. His first idea might, perhaps, be, to place them in alphabetical order, so as to form a kind of Dictionary; this being the most easy method of fulfilling his task, and also having the advantage,

when complete, of admitting very easy reference to any required subject. But what idea would the reader of such a volume gain, of the plan which the original Author had in his mind? Or what connected and harmonious scheme of knowledge could he frame from them, unless he digested and arranged them in his own mind, in the manner in which we shall suppose our Man of Science to proceed to do? He might commence in two ways;—either by separating the whole into heaps, according to the subjects to which they respectively refer, *e. g.* Mechanics, Chemistry, Geology, Botany, Zoology, &c. and then arranging these singly;—or by endeavouring to join the separate paragraphs together, according to their obvious connection. He will probably find a combination of these two methods the most advantageous; and by a careful examination of each single paragraph, in its relations to the whole, he may at last succeed in producing a series of connected Treatises, methodically arranged according to their respective subjects, and regularly divided into chapters, very nearly, or even exactly, upon the plan of the original Author. Now the Alphabetical arrangement would bear a close parallel with the Linnæan system of Botanical classification; whilst the latter distribution,—the one evidently most calculated to convey to the learner a *connected* rather than a *desultory* knowledge of the several objects of his pursuit, may not unaptly represent the Natural System.

487. It is by seeking for the latter only, that any of those general principles can ever be attained, which give their chief value to the facts of Science, and which lead us higher and higher in the contemplation of that Almighty Power and Boundless Wisdom by which the Universe was framed; for *the* Natural System would be but a Table of Contents of the Vegetable Kingdom, arranged on the plan of its Divine Author. In order to attain it, the Botanist requires to become acquainted, not only with all the tribes of Vegetables at present existing on the surface of the globe, but with the forms and characters of those which have once existed; since—it cannot be doubted—all these constituted parts of the one general scheme, without the knowledge of which it would be impossible to reconstruct it. Now it is well known to the Botanist,

that a very large number of the species of Plants with which he is somewhat acquainted, have been so imperfectly examined and described, that their true place in the system cannot be determined; and there is good reason to believe that there are many more of which he is totally ignorant. Here, therefore, are abundant causes for the imperfection of any natural system which can be at present framed; and should these ever be removed by long-continued labour and research, there will yet remain the other causes, resulting from the impossibility of becoming fully acquainted with the characters of the races which have existed in former periods of the earth's history, and have been swept completely from its face. Of these, some remains are occasionally discovered, sufficiently perfect to excite the liveliest interest and curiosity, by showing that races formerly existed, which fill up many of the wide gaps existing between those with whose characters we are now familiar, and which, if we knew more of them, would explain many things that are at present most perplexing.

488. Some of the strongest upholders of the Linnæan system are influenced by their veneration for its author; whose fame, however, will rest on a foundation much more durable than this. It is not generally known that the advantages of the Natural method have never been more highly appreciated, than they were by Linnæus himself. When he framed an Artificial system for the convenient arrangement of plants, it was with the very purpose for which the temporary employment of it has been here recommended,—namely, to facilitate that acquaintance with the Vegetable Kingdom, which must be gained before a Natural method can be framed. Linnæus himself gave a sketch of the Natural System, explaining the principles on which it might be expected to rest; and he pronounced the investigation of the natural affinities to be the great object of his studies, and the most important part of the science. He considered the Artificial system as a temporary expedient, which, however necessary at that day, would inevitably give place to the system of nature, so soon as its fundamental principles should be discovered. The elucidation of the latter, he said, is the first and ultimate aim of Botanists; to

this end the labour of the greatest Botanists should be diligently directed; and the merest fragments of this system should be carefully studied. Though not then fully discovered, he spoke of the pursuit of it as held in high estimation by the wisest Botanists, and as being thought of little consequence only by the less learned. " For a long time," he adds, " I have laboured to establish it; I have made many discoveries, but have not been able to perfect it; yet while I live, I shall continue to labour for its completion. In the mean time, I have published what I have been able to discover; and whosoever shall resolve the few plants which still remain, shall be my Magnus Apollo. Those are the greatest Botanists, who are able to correct, augment, and perfect this method; which those who are unqualified should not attempt." Those therefore, who, priding themselves upon their being disciples of Linnæus, continue to employ his temporary and artificial system of classification, to the exclusion of one founded upon Natural principles, imagining that they are upheld by his authority, quite mistake the views of their great master, and sadly misrepresent his opinions.

489. The knowledge of the Vegetable Kingdom obtained by Linnæus, however, was far too small in amount, to enable him to frame a Natural System upon sound principles. The number of species known to him was probably not an eighth part of those with which Botanists are now acquainted; and no arrangement, therefore, could be formed, which was not marked by many wide and unsightly gaps. Further, so little was at that time known of the internal arrangement of the organs of plants, that even the distinction between the two principal forms of structure in the stem,—evident and well-marked as it now appears,—was not then understood. Nevertheless, with that sagacity which so remarkably characterized him, Linnæus succeeded in grouping together genera into orders, which are even now regarded as, for the most part, very natural assemblages; that is, as containing plants really allied to each other in their most important characters, and differing from those of other orders in the same. But of the best mode of arranging these orders he was necessarily ignorant, since the *most* important characters were not then understood. The

great progress which has been made since his time, in the Structural and Physiological departments of Botanical Science, has done much to place Classification on a more certain basis; yet there is still much wanting, before Botanists shall be generally agreed on the principles which shall regulate the division and subdivision of the Vegetable Kingdom. In the following outline, the object is less to give a bare sketch of the entire system, than to offer such a view of it, as may serve to show its nature. It is intended to describe most fully those Orders to which the greatest number of British Plants belong; and to state the relations which the species of most importance to man, whether as furnishing articles of food, valuable medicines, or materials for his various arts, bear to these. In so doing, it has been deemed advisable to adopt the Classification of De Candolle, that being the one which is most in use at the present time; and the principles upon which it is founded will, therefore, now be explained.

490. It may be remarked, however, in the first place, as a principle common to all Systems of Classification which profess to be Natural, that the different values which are attached to the various characters furnished by the several organs of plants, should be estimated by the degree in which they respectively indicate important similarities or differences of *general* conformation. It often happens that attention to one or two characters may afford a considerable amount of knowledge of the whole; because those characters are found to be inseparably connected with others. An instance of this has been already given, in regard to the primary division between Exogens and Endogens (§ 478.); and it may be useful to illustrate it further by reference to the Animal kingdom. If, for example, we meet with an Animal covered with feathers, we at once know a great deal of its internal structure and economy. It is a *Vertebrated* animal, possessing a jointed back-bone and complete internal skeleton; it has all five senses; its blood is red; it breathes air; its temperature is high; its young are produced from eggs; it walks upon two legs; &c. &c. Here we are at once informed that this unknown animal possesses all the characters peculiar to the class of Birds; since no other animals than Birds

possess a covering of feathers, which is inseparably connected with the whole plan of their structure and economy. In the same manner, the classification of the Mammalia (Quadrupeds) according to their teeth, proposed by Linnæus, proves to be a very natural one, although founded upon a single set of characters; because the form and number of the teeth vary with the nature of the food on which the animal is intended to live; and to make use of this, a certain form of digestive apparatus is adapted; as well as a certain kind of general structure, furnishing the instruments by which the food is obtained: so that these may be known to a great extent from the inspection of the teeth alone. In like manner the Botanist, whilst founding his arrangement upon the whole group of characters which each Plant exhibits, endeavours to select those, as marks for distinguishing the several divisions which are at once easily recognized, and which serve as the best key (so to speak) to those which are seated within. Such characters are Natural, then, in proportion as they indicate *general* conformity or difference of structure; thus, the distribution of the veins of the leaves,—a character easily recognized,—will in general serve to distinguish Exogens and Dicotyledons from Endogens and Monocotyledons; and it is therefore a very natural character, serving as a key to all those which are indicated by these terms. On the other hand, the number of stamens and pistils in a flower is a purely artificial character, since it gives no further certain information of the general structure of the plant.

491. Another general principle of natural classification must next be pointed out. When a number of Plants or Animals are associated, on account of their general resemblance to each other, into a Natural Group, it will be found that the characters in which they agree are presented by some members of the group much more prominently than by others; and that in some they are occasionally so much wanting, that these can scarcely be regarded as connected with the rest; yet they would not seem to be more easily included in any other groups. Now those members of a natural group which most strikingly present an union of all the characters by which it is distinguished, are spoken of as its *types*;

and those in which these characters are less obvious are termed *aberrant* members of the group. It is by these, in fact, that natural groups are connected with one another; for it will generally be found that in the aberrant members of one group, its characters become (as it were) gradually shaded off, until they almost blend with those of the next. To revert to an illustration formerly (§ 18) employed;—where the countries occupied by two nations are not separated by any marked natural boundary (as a broad river or high chain of mountains), the peculiar characters of these nations, which may be regarded as most strongly exhibited in their respective chief towns, become gradually blended towards the border where they meet; so that the transition from one to the other is by no means so abrupt, as if the traveller were conveyed at once from the metropolis of each to that of the other. Every natural group, then, may be regarded as a sphere, surrounded by other spheres, each representing another group, which touch it at certain points; the *type* of each will occupy its centre; and the *aberrant* members will be disposed in various positions around it, in proportion as they lose *its* peculiar characters and approach other groups. For example, the group of Lizards is intermediate between that of Serpents and that of Tortoises. There are some Lizards in which the body and tail are greatly lengthened, whilst the legs are shortened, so that the form of the Snake is approached; and in the common Slow-worm or Blind-worm of this country, the external form is completely that of a Snake, whilst beneath the skin two pairs of small though perfectly-formed legs may be found on careful examination. This, then, is an *aberrant* form, situated just on the border of both groups, and scarcely having a certain claim to a place in either. On the other side, the Lizards are connected with the Tortoises by an American species commonly known under the name of the Alligator-Tortoise, or Snapping-Turtle, which may be considered as a Tortoise with a long Lizard-like neck, legs, and tail, or as a Lizard with a Turtle-shell on its back. The Lizards are connected, again, with Birds (to which they would not seem to have the slightest possible relation), by means of a very curious animal not now existing, which had the general structure of the

Lizards; but which had the fore-legs converted into wings like those of a Bird; and which seems to have been covered with something intermediate between scales and feathers. Many similar instances will present themselves in the study of the Vegetable Kingdom.

492. Hence when it is stated that a Plant or Animal belongs to a particular group, it is by no means necessarily implied that it possesses *all* the characters which are considered as marking that group. Thus,—to revert to an instance just now employed in illustration,—the structure of the feathers, which are generally so characteristic of the class of Birds, is greatly modified in some of the species which approach nearest to other groups; in the Emu, for example, (one of the Ostrich tribe) the feathers are little else than stiff branching hairs; and in the Penguin, those covering the fin-like wings resemble scales. So, again, in the first Natural group of plants which we shall consider,—the *Ranunculus* or Crowfoot tribe,—there are some species which have the parts of the flower arranged in *threes*, as in Endogens; yet they are not really such, for their stems are Exogenous, the veining of their leaves is netted, and their embryo is dicotyledonous. Again the common *Arum maculatum* (Cuckow-pint or Wake-robin) has reticulated leaves; but it is not an Exogen, because its stem is Endogenous, and its embryo monocotyledonous. And the Pondweed *(Potamogeton)* has the parts of its flowers arranged in fours; yet it does not belong to Exogens, since its leaves are parallel-veined and its embryo is monocotyledonous.

493. In considering the value of the several characters afforded by the varieties in the structure of Plants, it will be convenient to follow the same order as that which has been adopted in describing that structure. The Elementary Tissues do not afford any means of distinction, except in regard to the primary divisions,—the presence of Spiral Vessels being on the whole characteristic of Flowering Plants (which have been hence termed *Vasculares);* and their absence being nearly constant in Cryptogamia (which have been hence termed *Cellulares*). There are some of the inferior Phanerogamia, however, in which no spiral vessels can be

detected; and in the Ferns, which stand at the head of the Cryptogamia, traces of them may be found. However, if on examining any portion of the fabric of an unknown plant, spiral vessels were distinctly seen, this might be regarded as sufficiently indicating that the specimen belonged to the higher of these two groups. The peculiarity of the woody fibre in the Coniferæ and allied orders, together with the absence of the dotted-ducts or special sap vessels, is characteristic of that portion of the Phanerogamic division; but excepting in this instance, no use can be made of the varieties of the elementary tissues, in defining the subdivisions of the classes of Plants.

494. The structure and mode of increase of the Stem afford, as already stated, the means of establishing the soundest division of the Phanerogamia: and the two groups of Exogens and Endogens are universally recognised as natural classes. Between these, however, there are several connecting links,—some Exogens exhibiting in their stem, no separation into annual layers,—and some Endogens presenting an approach to the Exogenous division of the kingdom. One small order (Calycantheæ) is known by the presence of four incomplete centres of vegetation surrounding the principal one; and the Passion-flower tribe are remarkable for having the stem almost cut into four quarters: whilst a square stem is universal in the Dead-Nettle tribe. In some orders, such as the Cacteæ (Prickly-Pear tribe) and Euphorbiaceæ (Spurge Tribe), the quantity of cellular tissue usually so much predominates that the stems are soft and succulent; but this is not always the case, some genera having stems of the ordinary character. No very positive characters can in general, therefore, be drawn from the structure of the stem, in dividing the classes into sub-classes and orders. Nor do the Roots afford any better guide; since the modifications of form of which they are susceptible are very few, and they are by no means constant in particular groups. As a general rule, however, it may be observed that neither bulb nor rhizoma (§ 149, 150) are found in Exogens, and that they are confined to a few orders among Endogens.

495. The Leaves are subject to considerable modifications, both

in position, form, and structure, which are very useful in classification. The general differences among the leaves of Exogens, Endogens, and Acrogens, have already been several times adverted to. The relative position of the leaves, as whether alternate, opposite, or verticillate, is often a very important character; but in regard to this, as well as to other characters, it often happens that it is of much greater value in some orders than it is in others. Thus in Lamiaceæ they are uniformly opposite: so that no plant can belong to the order, in which they are alternate or verticillate. In Urticaceæ (the Nettle tribe), on the other hand, they are constantly alternate; so that no opposite-leaved plant can belong to the order. In this manner the common Dead-Nettles and Stinging-Nettles may be at once known from each other. But in many others, one arrangement is prevalent, and yet the other sometimes occurs. The degree of division of the leaves, again, is subject to considerable uncertainty in many orders, from causes formerly adverted to (§ 234—9); yet in others a constant form is maintained; thus, leaves with teeth or jagged edges are never found in the order Cinchonaceæ (from which the Peruvian Bark is supplied), and they are very rare in Endogens. The particular characters afforded by the veining of leaves are much more constant, as formerly shown (§ 235), than those derived from their form; and it is probable that, as they have only been recently attended to, much assistance will be obtained in classification from an increased knowledge of them. A character which would not at first sight appear of much importance, is afforded by the presence or absence of those little dots in the leaves, which are reservoirs of oily secretions; yet these, being connected as it would seem with some important differences in the general economy, are extremely characteristic of certain natural orders, such as Myrtaceæ, the Myrtle tribe, and Aurantiaceæ, the Orange tribe, serving to distinguish all their members from those of other orders nearly allied to them. In other orders, however, there are some genera with, and others without these pellucid dots. The clear or milky character of the juices of the leaves and stalks, indicating as it does the absence or presence of certain secretions which are characteristic of particular orders, will often prove of much use in distinguishing their members. At the base of the leaf-stalks are often found little leafy appendages (which are in fact leaves, in an imperfect state of development), termed Stipules; the presence or absence of these frequently enables the Botanist to distinguish the plants of two allied orders, of which one possesses them, whilst the other does not; and certain peculiarities in them, which will be hereafter noticed, are occasionally very characteristic of particular groups.

496. Passing on to the Flowers, we first have to notice the characters afforded by the bracts; these are seldom of any use in distinguishing orders, on account of their constant variation within the limits of each; but they are often valuable in separating genera and species. The calyx is used in a variety of ways tc distinguish orders; but the characters it affords are far from being of equal or uniform importance throughout. The number of sepals is sometimes a very useful and constant mark of a particular order; thus, in Cruciferæ, the Cabbage and Turnip tribe, they are always four, and in Papaveraceæ, the Poppy tribe, always two: but in many orders it is extremely variable. The equal or differing size of the sepals is another character of great importance in some cases, but not to be regarded in others. Again, the union of the sepals by the adhesion of their edges, is a character to which great value may usually be attached; when this adhesion unites all the sepals, the calyx is commonly said to be *monosepalous* (single-sepalled); but the term *gamosepalous*, expressing the union or adhesion of the sepals, is to be preferred. A still more important character is the degree of adhesion of the calyx to the organs it includes. Where it arises immediately from the disk or expanded top of the flower-stalk, and where the corolla, stamens, and pistil are quite distinct from it, arising by themselves from the disk, as in Fig 65, the calyx is said to be *inferior* to the ovary, or non-adherent to it. But where the calyx seems to spring from the top of the ovary or seed-vessel, instead of beneath it, it is called *superior;* this conformation is due to the adhesion of the calyx to the wall of the ovarium, so that it forms a tube com-

pletely enclosing it, as in the Rose, Apple, &c. In some plants the calyx is altogether absent; and then the general rule is that the corolla is likewise deficient. Such plants are said to be *Achlamydeous*, the essential parts of their flowers being destitute of envelope. In the Compositæ, however, which possess a corolla, the calyx is present in an undeveloped form, constituting the *down* which surrounds the bottom of the corolla, and is attached to the top of the seed, as in the Dandelion.

497. In regard to the number and regularity of the parts of the corolla, nearly the same may be said as of the calyx. These characters are valuable in some instances and not in others. The separation or adhesion of the petals, constituting what is commonly known as the polypetalous or monopetalous corolla, is often a character of first-rate importance, as will presently appear. Still, from the cause formerly mentioned, (§ 456) it is liable to some uncertainty, and must not, therefore, be trusted too implicitly. Sometimes no corolla is to be found, the calyx still being present; and the plant is then said to be *apetalous* (destitute of petals) or *Monochlamydeous*. This is a character, however, on which great reliance cannot be placed; since *apetalous* genera frequently present themselves in orders which usually possess complete flowers,—an occurrence which is less common amongst monopetalous Exogens than among those which have separate petals, so that the character is of more value in the former than in the latter.

498. When our attention is directed to the more essential parts of the flowering system,—the stamens and pistil,—we meet with some characters on which more constant reliance can be placed; but these are not among the most obvious, such as the inexperienced Botanist would first attend to. For example, the number of stamens is a character to which little importance can be attached; since this is liable to vary extremely among the genera of almost every order,—in many cases among the species of the same genus,—not unfrequently, among individuals of the same species,—and even in different flowers on the same plant. Yet there are particular orders, in which the number of stamens is very

constant throughout, and is very characteristic of them. The most important characters afforded by the stamens, are drawn from their mode of origin from the lower part of the flower. They may arise, like the sepals and petals, from the disk, beneath the ovary; in this case they are said to be *hypogynous* (this term designating their origin from *beneath* the *female* part of the flower). A sectional view of a flower constructed upon this plan is shown in Fig. 65; the sepals of the calyx, the petals of the corolla, the stamens, and the pistil, are there shown to be all separately implanted on the disk. But it may happen that the sepals and stamens arise together, (these parts being opposite in a regular flower, whilst the petals alternate with them so as not to prevent their adhesion § 463,) and that they adhere for a part of their length, so that the stamens appear to arise from the calyx, and come away with it when it is detached; in this case, or when they adhere in a similar manner to the petals, they are said to be *perigynous*, having their origin *around* the female organ. A plan of such a structure is shown in Fig. 66. Lastly, when the calyx embraces the ovarium, it also closely envelopes the stamens, which are not freed from it except at the top of the seed-vessel; in this case, the stamens, appearing to arise from the top of the ovarium, are said to be *epigynous*, being seated *upon* the female organ. This mode of conformation is illustrated by Fig. 67, which also explains what was meant by a *superior*

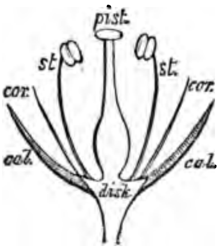


Fig. 65.

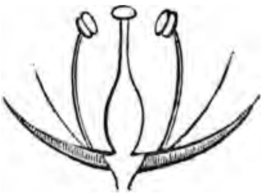


Fig. 66.

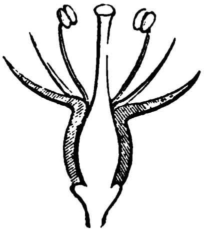


Fig. 67.

calyx (§ 496.). Peculiarities in the mode in which the anthers open to disperse the pollen are sometimes characteristic of particular orders; thus the Berberry and Laurel tribes have anthers bursting by valves; and the Heaths have anthers opening by pores (§ 433.). But such peculiarities are found in other genera, amongst orders which do not possess them; and they must not, therefore, be implicitly relied on.

499. Of all natural characters, those furnished by the structure of the central parts of the flower are perhaps subject to the fewest exceptions; yet these are not such as are the most evident to the ordinary observer. On the number of styles, as already stated, little reliance can be placed for the establishment of important distinctions; but as it is less liable to vary than is that of the stamens, it may often be useful in the separation of genera. A much more decisive character is afforded by the degree of adhesion among the carpels; when they remain distinct from each other, the ovary is said to be *apocarpous* (carpels apart); and when they are compactly united, it is termed *syncarpous* (carpels together). There are few natural orders in which one or other of these conditions does not prevail, to the entire exclusion of the other; so that plants which bear a strong resemblance in general aspect, but differ in this, may be at once referred to their proper groups. The *position* of the ovary in respect to the calyx has been already adverted to; this character is generally expressed by the terms *inferior* or *superior* ovary. The presence or absence of partitions in the ovaries, is a very important distinction. An ovary may be one-celled, because it consists of but a single carpel; or, being *syncarpous*, it may contain an undivided cavity, from the obliteration of the partitions, or dissepiments, originally formed by the walls of the several adhering carpels. In this case, the attachment of the ovules, or *placenta*, is either *central*, the ovules being clustered around a central column (as in Fig. 49, § 434) or *parietal*, where they are attached to the outer wall (as in Fig. 50.) Varieties of structure of this nature are very important in distinguishing orders. A peculiar enlargement of the receptacle, which expands between the bases of the

carpels so as to separate them more or less completely (§ 470), as in the Strawberry, is often very characteristic of particular orders. The ripened ovary or fruit exhibits numerous and remarkable differences in its form, substance, and mode of dehiscence (or its manner of bursting when ripe); but these do not usually receive much attention from Botanists; since, although there are a few orders which are characterized by a particular kind of fruit, most others present numerous varieties among their different genera.

500. Many valuable characters are drawn from the seed, both in its early and mature conditions. The number of ovules,—that is to say, whether they are definite or indefinite,—is frequently an important difference; still in some orders, there are genera nearly-allied, in one of which the number is definite, whilst it is indefinite in the other. The position of the ovules is more essential than their number; the chief distinctions are between those which, rising upright from the base of the cavity, are termed *erect;* and those which, hanging from its top, are called *pendulous.* Between these two conditions, however, there are other intermediate ones. Such a difference in the position of the ovules often serves to mark a distinct line of separation, between the plants of two groups that are otherwise nearly allied. In the perfect seed, the number of cotyledons is a character of primary importance, for distinguishing the two great classes of Phanerogamia, as already several times stated. Even this, however, is subject to occasional exceptions; for there are Endogenous Plants with two cotyledons, and some Exogens with only one, or even none; whilst again, some Exogens have several. As a means of distinguishing orders, the presence or absence of a separate albumen (§ 439) is a character of great value, especially when the embryo bears a very small proportion to it in amount, as in the orders we shall first have to consider. Where, however, the embryo and albumen are nearly equal in size, the character is of less importance; so that it is not uncommon to meet, in the same order, with some genera, of which the embryo alone fills the seed, and with others in which a part is occupied by albumen; whilst in the orders especially characterized by it, there is probably

not a single genus in which it is absent. It must be remembered that albumen exists in all seeds at an early period of their formation; and that the subsequent difference will depend upon the degree in which it is absorbed by the embryo.

501. The student, who has given attention to the preceding statements, is not unlikely to feel some perplexity, on account of the constant uncertainty which has been stated to attend the value of the several characters that have been enumerated. But as he proceeds further, he will find that this uncertainty is greater in appearance than in reality; and that it necessarily results from the properties of a Natural Group, as already described. In dividing the Vegetable Kingdom on an Artificial Method, it seems very easy to lay down a small number of characters as the standard; and to bring together, or to separate, Plants, according to their conformity or variety in these. But, as has been already shown, when we come to apply this plan, numerous difficulties are met with, in consequence of the differences which are of constant occurrence, among plants belonging to the same genus or even to the same species (§ 481); so that even here, the Botanist must be guided by *general* resemblance. Now although it is quite true that no *single* characters, when traced throughout the Vegetable scale, can be relied on, as indicating the Natural Affinities of plants, yet experienced Botanists have little difficulty in defining each order, by a certain *combination* of characters which are peculiar to it; and not unfrequently, the plants belonging to one order may be separated from those of all other groups, by some evident and well-marked peculiarity.

502. On the foregoing principles, the Class of EXOGENS is divided by De Candolle in the following manner.

The first group consists of those, of which the Flowers possess both calyx and corolla, and in which the petals of the latter are distinct, and which are therefore *Polypetalous*. This group is divided into two Sub-classes according to the mode of insertion of the stamens.

Sub-class 1. *Thalamifloræ.* Polypetalous Exogens, in which the stamens arise from the disk,—that is, are *hypogynous.* Sometimes the stamens adhere slightly to the sides of the ovary, but they are never epigynous, nor perigynous (§ 498.).

Sub-class 2. *Calycifloræ.* Polypetalous Exogens, in which the stamens arise from the calyx or corolla,—that is, are *perigynous.*

In the next Sub-class, the flowers, still possessing both calyx and corolla, have the latter formed of united petals, or are *Monopetalous.* In this division, the position of the stamens is not regarded as a primary character.

Sub-class 3. *Corollifloræ.* Monopetalous Exogens.

In the lowest group, the corolla is always absent, making the flower *Apetalous;* and the calyx is not uniformly present. This character is regarded as sufficiently marking the group.

Sub-class 4. *Monochlamydeæ,* Apetalous Exogens.

The object of this classification is to proceed from what are considered the most perfectly-organized Exogens, to those which are least so. Thus all the parts are present and distinct from each other in *Thalamifloræ;* other things remaining the same, the stamens adhere to the perianth in *Calycifloræ;* the petals join together in *Corollifloræ;* and in *Monochlamydeæ* first the corolla disappears, and then, among the most imperfect orders the calyx ceases to be developed.

503. The Class of ENDOGENS is not divided, by De Candolle, into any Sub-classes. It will, however, be convenient to consider their orders as characterized by the completeness or incompleteness of their flowers. The *Complete* Endogens may be again sub-divided into those with a *superior,* and those with an *inferior* ovarium. The orders having *Incomplete* flowers are separated into those, in which a cluster of flowers is inclosed in a single large bract, termed a *Spathe,* which is frequently coloured (as in the Arum tribe); and those in which the perianth of each flower is replaced by scale-like bracts, as in the Grasses.

Class I. EXOGENS.—Sub-class I. THALAMIFLORÆ.

Order RANUNCULACEÆ, or Crowfoot Tribe.

4. If we examine the structure of the flower of the common vfoot or Buttercup, so abundant in our meadows as to be every re easily found, we shall observe the following to be the plan of onstruction. Beneath the yellow petals, there may be seen *five* small greenish-yellow leaflets; these are the *sepals* of the calyx: they fall off shortly after the flower opens (§ 455). Within these are *five* other leafy organs, of a bright yellow colour on both sides, which give to the Buttercup its gay and glittering appearance; they stand up and form a little cup, in the bottom of which the other parts of the flower are curiously arranged; these are the *petals* of the corolla. At the base of each will be seen, on the inside, a little scale, from which honey exudes. Within the corolla are found a large number of stamens, with very short filaments; which, like the sepals and petals, are all separately implanted on the receptacle. Almost buried within the stamens, and occupying the centre he flower, are a number of little green grains, collected were in a heap, and seated upon a small elevation of the ptacle, into which the stamens, petals, and sepals are all sepa-y inserted. They are too small to be seen readily without a nifying glass; but when enlarged in that way, they are observed e rounded at the bottom, and contracted into a sort of short bent

68. Flower-stalk of Mea- Crowfoot; on the right, an flower and dry fruit; on eft, expanding buds; *a, a,* s; *b,* calyx.

horn at the top. Each of these is a single *carpel*- the horn-like projection is the *style* which it bears; and the tip of this, which is rather more shining, and somewhat wider than the style itself, is the *stigma* (§434). Every one of these carpels contains a single ovule or young seed; it requires, however, some dexterity to make its contents apparent. The ovule, when young, occupies but a small part of the cavity of the carpel; in time, however, it increases, so as to fill it completely. After the calyx, corolla, and stamens have fallen off, the cluster of carpels remains and ripens into the fruit of the plant. They undergo little change of form, though increasing in size; but they become dry, brown, and hard, resembling seeds. Though they are ordinarily taken for such, they are, as just shown, the seed-vessels, each containing but one seed. When this is the case, as it is in Corn, the carpels are termed *grains*. If the grain be cut through, nothing but a solid mass of white flesh will be met with, of which all the portions seem alike; but if the section have passed exactly through the centre, there may be distinguished, near the base of the seed, a minute oval body, which may be taken out of the flesh upon the point of a needle. This oval body is the *embryo* of the young plant, with its two *cotyledons*; and it is embedded in a separate *albumen* (§ 439.).

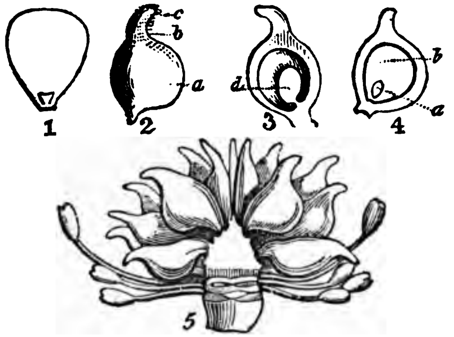


Fig. 69. Parts of the flower of the common *Ranunculus*, or Buttercup; 1, one of the petals, with the scale at the bottom on the inner side; 2, one of the carpels, showing *a*, the ovary, *b*, the style, and *c*. the stigma; 3, section of the carpel, showing *d*, the ovule within it; 4, section of the mature carpel filled with the seed—*a*, the embryo, *b*, the albumen; 5, the carpels and some of the stamens, implanted on the receptacle.

505. On looking at other parts of the plant, it will be observed that the leaves are dark-green; and that they are very much divided by deep indentations. It will further be remarked that their form is simpler at the upper part of the stem than near the root; the lobes or chief divisions being narrow, and not themselves divided, in the former case; whilst in the latter they are more expanded, and their edges are deeply cleft. At the bottom of the flower stalk may be observed a couple of small leafy bodies, which are the *bracts* (§ 457). These, as formerly stated, are intermediate in character between the true leaves and the leafy portions of the flower; and of this fact the species under observation affords a remarkable illustration. Two specimens, pulled at random from the nearest field, are now before the writer; in one the bracts are simple in their form, like the sepals of the calyx; in the other they are cleft into three lobes, and more resemble ordinary leaves.

506. Now the foregoing characters are those by which the order RANUNCULACEÆ is separated from other tribes; but they are *not all* presented by every plant, which, on account of its *general* resemblance, is placed in the same group with the common Crowfoot. For example, there are some which have 3 or 6 sepals in their calyx, instead of 5, the regular number. The petals, again, are sometimes more numerous than 5, and sometimes altogether wanting. The number of stamens is quite indefinite. That of the styles is also variable, since the styles of the different carpels may unite into a single one, or into a small number, or may remain (as in the common Ranunculus) entirely distinct. The number of seeds in each carpel is not restricted to one. It will be asked then,—what are the *essential* characters by which this natural group is marked. They are simply these. The stamens are numerous, and arise from the disk beneath the carpels; and the carpels are themselves distinct. The structure of the other parts of the flower may or may not be conformable to that of the common Ranunculus; and it is in fact by the minor variations that the order is subdivided into genera. The greatest general resemblance of the flowers of this group is to those of Rosaceæ; but they may be at once distinguished by the position of the sta-

mens, which in the latter, are adherent to the calyx, instead of arising at once from the receptacle.

507. All the plants agreeing in these general characters, also agree in their properties; for their juice is constantly acrid and nauseous, though in a degree which varies in the different species. In some of them, there is also a certain amount of a narcotic principle. These properties cause several species to be useful in medicine, as will be presently noticed; but they prevent them from being of much utility as food, causing them to be usually rejected by cattle, which eagerly devour the harmless plants around. The Ranunculaceæ further agree in being either herbaceous or shrubby plants, never rising to the dignity of standard trees.

508. Of the *Ranunculus* itself, many species are natives of Britain. The commonest are the *R. acris* of our meadows, and the *R. sceleratus*, or Celery-leaved Crowfoot of the sides of pools and ditches. Both these derive their specific names from the acridity of their juices, which excoriate the skin, and even form ulcers that are difficult to heal; and simply carrying specimens in the hand for a short time will sometimes inflame its surface. The *R. aquatilis*, or Water Crowfoot, is one of the least virulent of the order; and in some parts of the country, where it abounds, it is employed by cottagers as a fodder for cows and even horses. There is a curious distinction between the leaves of this species, some being submersed beneath the water in which the plant grows, whilst others float upon its surface; the former are subdivided into a large number of rounded hair-like filaments; whilst the latter are but little separated into lobes. Some foreign species of Ranunculus are much cultivated in gardens, on account of the beauty of their flowers, which have a tendency to become *double*, that is, to have one or more additional whorls of petals developed within the ordinary corolla, at the expense of a corresponding number of stamens.

509. To this group also belong the well-known *Anemonies*, whose flowers are so attractive with their white, blue, or purple petals, on wooded banks. In these the petals and sepals cannot be distinguished, the latter being coloured like the former. They

exhibit a remarkable tendency to variation in the character of the flower, usually depending upon the amount of nutriment which the plant receives (§ 461). Sometimes the sepals revert to the form of ordinary leaves, whilst the petals exhibit a greenish tinge, and the stamens of the outer row approach the petals in character. The transformation may extend farther inwards,—the petals becoming quite green, the outer stamens resembling ordinary petals, and the inner ones presenting an approach to the same form. Every shade and variety of metamorphosis may be met with, until all the parts of the flower, carpels as well as stamens, are found to have been transformed into leaves, of which the inner ones are most simple, whilst the several whorls change in their character towards the form of the exterior one, which corresponds with that of the ordinary leaves of the plant. When the flowers of the Anemone have dropped off, there is seen in its place a little tuft of feathery tails or oval woolly heads, in place of the clusters of grains which are found in the Ranunculus. These tails are nothing but the styles of the carpels, grown large and hairy; they probably serve the purpose of *wings*, by the action of the wind upon which, the carpels containing the seed are dispersed. The *Hepaticas* differ little from Anemonies; they were once in repute for their supposed medicinal virtues in diseases of the liver; but they are now esteemed merely as ornamental garden plants, and it is curious that they may often be seen to thrive when neglected in a cottage garden, whilst they perish under greater care, as if they were created specially for the pleasure of the poor.

510. Another subdivision of the order is that which contains the *Clematis*, a genus of climbing plants, of which the species native to Britain is known under the name of Traveller's Joy; and another, which is much cultivated in gardens, is commonly called Virgin's Bower. These are almost the only plants of the order which form woody stems; they grow in hedges and against walls, their petioles being prolonged as tendrils; and, in spite of the acridity of their juices, their flowers are mostly fragrant.

511. A group which departs more widely from the ordinary characters of the tribe is that which includes the *Hellebores* and

their allies. The irregularity of these chiefly lies in the petals and stamens. In the *Trollius*, or Globe-flower, which inhabits moist mountain pastures in this country, and is conspicuous with its large handsome flowers, the petals are contracted into little tubular bodies, scarcely exceeding the stamens in size, and it is to the petalline character of the sepals, which are usually about 15 in number, that their showy aspect is due. The *Caltha*, or Marsh-Marigold, which grows in large green tufts in meadows and by the sides of ditches, has no petals at all. The common *Green Hellebore*, abundant in woods, thickets, and hedges, especially in calcareous soils, and the *Stinking Hellebore*, a bushy plant of similar habits, are easily known by their large greenish-yellow sepals, and their small irregular petals. A foreign species of Hellebore is cultivated in our gardens under the name of Christmas Rose; here the substitution of petals for stamens, and the general aspect of the plant, make the resemblance to the order Rosaceæ very striking; but the flowers are easily distinguished by the characters already mentioned. The Hellebores were formerly in great repute for their medicinal virtues, especially in the cure of mental derangement. The Black Hellebore of the ancients grew plentifully near Anticyra, a city of Phocis in Greece; whence arose the proverb, applied to any one who acted in an absurd manner,—"Naviget Anticyram," "let him sail to Anticyra." They are now disused, however, as their purgative properties are so violent, as to render their employment dangerous. The *Aquilegia* or Columbine, and *Delphinia*, or Larkspur, belong to this group; a species of each genus is a native of Britain; but others with much more showy flowers, obtained from abroad, are cultivated in our gardens. They are both distinguished by great irregularity in the petals, these having long tubular spurs, of which the small scale at the bottom of the petal of the Ranunculus may be considered as the rudiment; and in the latter, the several petals differ in form, two only being spurred; and one of the sepals of the calyx has a horn, in which the two spurs are hidden. Both these plants have been employed in medicine, but are now disused for the same reason as the Hellebores.

512. The most irregular of all the flowers we have to notice in this order, is that of the common *Aconite*, ordinarily known as Wolf's-bane or Monk's-hood; this is occasionally found wild in this country, although it has probably escaped from gardens, in which it is much cultivated, on account of its showy aspect. The sepals of this flower are purple-coloured, like petals; and one of the five is very large, resembling a sort of helmet, and overshadowing all the other parts of the flower. Of the petals only two are developed; and these are so much changed in form that they would be scarcely recognized as such; they are two fleshy bodies, mounted upon long stalks, projecting into the hollow of the helmet-shaped sepal. Three other abortive petals may generally be detected as little scales, when the calyx has been removed. The leaves and roots of the Aconite contain more of the narcotic principle than those of other plants of this order: if the former be chewed for a few minutes, a curious tingling sensation is experienced in the lips, showing that the nervous system is immediately affected. The extract made from them has been used with good effect in many nervous diseases; but in making it great precaution is required, as its properties are destroyed by a very moderate degree of heat. In this respect, the rest of the tribe resemble it; and the leaves of many, which would be very poisonous when fresh, may be rendered wholesome food for cattle by drying them with moderate warmth.

513. The *Pæonies*, much cultivated in our gardens, on account of their showy flowers, are generally considered as belonging to the Crowfoot tribe, although differing from it in some important particulars. Of these we may notice that the calyx, instead of dropping off at an early period, as in most of the order, lasts as long as the flower-stalk itself; and the carpels, instead of being numerous, are diminished to 5 or even 2, containing, however, many seeds, and having an elongated form. In the species which is wild in Britain (though only met with in one or two localities) there is only a single row of petals; but, as in the Anemone and many plants of this tribe, the cultivated species have the number very much increased, so that the stamens may be even entirely replaced

by them, and the outer ones then approach the sepals in character. The gradual transition in the form of the leafy parts, between the lower portion of the plant, and the centre of the flower, which may readily be observed in the common Garden Pæony, has been already noticed (§ 457—9).

514. As a considerable number of stamens is characteristic of the plants of the order Ranunculaceæ, when not modified by cultivation, they mostly belong to the Linnæan class POLYANDRIA. The orders of this class under which they are included, are different, according to the number of styles which are developed. One British genus (*Actæa*, Bane-berry), allied to the Pæonies, has but a single carpel and style, and therefore belongs to the order *Monogynia*, where it is associated with the plants of the Poppy tribe. The Pæonies, Hellebores, Larkspurs, Columbines, and Aconites, have styles varying in number from 2 to 6, and are placed in the order *Pentagynia* (*five*-styled),—an example of the very loose and indefinite application of terms in this kind of classification. The only British genus associated with them in this order is the *Stratiotes* or Water-Soldier, so named from its sword-shaped leaves, which is an Endogenous plant belonging to the Frog-bit tribe. The Ranunculus, Anemone, Clematis, Marsh-Marigold, and their allies, having a large number of styles, are placed together in the order *Polygynia*, which contains no other British genus.

515. Succeeding the Ranunculaceæ in a natural arrangement, is an order apparently very different from it, of which a brief mention will suffice. This is the splendid *Magnolia* tribe, of which no species are natives of this country, but of which more than one has been introduced into gardens; and, although natives of warm climates, they thrive well in the milder parts of Britain, if protected by a wall. The Magnolias are for the most part large and beautiful trees, sometimes attaining the height of 90 feet, and surpassing almost all the other denizens of the forest in their superb

foliage, (the leaves sometimes attaining the length of three feet), and in their magnificent goblet-shaped flowers, that look as if they were chiseled out of alabaster. The East Indian species are most remarkable for the perfume they diffuse. It would scarcely be supposed, that these princes of the Vegetable kingdom should be allied to the humble Crowfoots we have been just considering; and yet the structure of their flowers shows them to be so. The Magnolia has a calyx of three small sepals, and a corolla of six petals; these numbers, though varied in the different genera, are usually multiples of three. The stamens are numerous, and arise immediately from the receptacle. In the centre of the flower there is a large number of carpels, each containing a distinct cell, and terminated by a narrow thread-shaped stigma. In no essential point, then, does the flower of the Magnolia, as yet described, differ from that of the Ranunculaceæ; there is this important variation, however,—that the carpels of the former grow together in some degree, so that the fruit, instead of consisting of a cluster of grains, appears as a solid cone.

516. There is a more important difference, however, in the leafy parts of the tree. There may be found in many plants, at the base of each leaf-stalk, a pair of small leafy bodies, which are called *stipules*, and which are to the leaves very much what the bracts are to the flowers. In the Magnolia the stipules are large, and perform an important function, to which there is nothing analogous in the Ranunculaceæ. Each of its branches is terminated by a little horn-like projection springing from the base of the last leaf; this horn is a pair of stipules, rolled together for the protection of the next leaf that is to be unfolded. That and the next leaf has a similar pair of stipules, which roll up over the still younger leaf lying at the base of its yet undeveloped petiole; and if the horn be cut through, several generations of leaves will be found thus enfolded one within the other. This is a characteristic peculiarity of the Magnolia tribe; and it has an interesting relation with the circumstances of its growth; for the bud is peculiarly tender, and requires to be protected from cold and accidents. In other plants we meet with different

provisions for this purpose; in this instance the stipules are made to perform the business of protection. The different parts of the plant, in all the known species of this order, contain, in greater or less degree, a bitter principle, which has been successfully used in medicine as a tonic, particularly in North America where this tribe most abounds; but it is not employed in this country.

517. Allied to the Magnolia tribe is the order ANONACEÆ, or Custard-Apple tribe, which is confined to tropical climates; it is best distinguished by the structure of its seed, the innermost coat of which forms several plaits or folds, that enter the albumen. The Custard Apple of the East and West Indies is a refreshing fruit, combining an agreeable acidity with sweetness; other species of the order have aromatic properties.

518. Another tropical order, intermediate between this and the one to be next mentioned, is that of MENISPERMACEÆ, the Cocculus tribe. These are twining shrubby plants, chiefly distinguished by the deficiency of parts in their flowers, which are constantly unisexual (the stamens and pistils never being developed in the same flower) and are sometimes diœcious (§ 435). The number of carpels varies considerably, as does also their degree of adhesion; so that it is altogether difficult to characterize the order, the different genera of which, however, correspond remarkably in the medicinal characters that render it chiefly interesting. The root is bitter and aromatic; that commonly known as Columbo root is much employed in this country as a tonic and stomachic; and that of other species is used for the same purpose, in the countries of which they are respectively natives. On the other hand, the seeds of most of them are narcotic, in various degrees. The drug named Cocculus Indicus is the seed of an Indian Menispermum; it has been much employed by brewers in this country to heighten the intoxicating properties of their malt liquor, so that it is now illegal for a brewer even to have the article in his possession; it has also been employed by poachers to capture fish, which it causes to become powerless and to float on the water. A large quantity is imported into this

country, in spite of the illicit nature of the uses to which alone it can be applied.

519. Another interesting order, possessing the same general structure, but having very different properties, is that of BERBERIDEÆ, represented in Britain by the common *Berberry*, a shrubby plant, frequent in hedges and plantations, and well known from the bunches of red succulent acid fruit which it bears. The branches of this bush are covered with sharp spines, in sets of three or more; and from the base of each set the leaves arise. Now these spines are nothing else than the hardened veins of the first-produced leaves of each bud, between which the fleshy tissue is not developed (§ 236); and this will become evident, on looking at a very vigorous shoot of the plant, which will exhibit at some points the space nearly filled up with parenchyma; at others partly so; and at others, the spines entirely bare. This is not, however an universal character of the *order;* but it is one which marks the common *genus* before us, as well as many others. The flowers present several interesting peculiarities. Their parts are generally arranged in threes, the number of sepals, petals, and stamens, being six in the common Berberry. The anthers open by *valves*, in the manner formerly described, (§ 432.) which character is sufficiently distinctive of this order; and the stamens possess a curious irritability, which also has been already noticed (§ 421). The position of the stamens is peculiar, being *opposite* to the petals,—a character which the Menispermeæ share with them. (§ 463—5). The ovary consists of only a single carpel, containing from one to three seeds; and it is this which in time changes to the oblong scarlet berry of the common Berberry, which genus of course belongs to the Linnæan class HEXANDRIA, and order *Monogynia.* The British *Epimedium* or Barren-wort, however, possessing only four stamens, is referred to the class TETRANDRIA; but there is a North American species which conforms to the general type in possessing six stamens.

520. Another order which may be briefly noticed, is that of NYMPHACEÆ, the Water-Lily tribe; the two common species of which.—the White and Yellow Water Lily (belonging, however,

to different genera)—are sufficiently well known. Much controversy has taken place, as to whether this order is to be ranked among Exogens or Endogens, as its herbaceous stem does not afford the means of satisfactory determination, and the structure of its leaves is such as might agree with either group. Here, however, the *number* of the parts of the flower, which are arranged in *fives*, affords important assistance; and, in spite of some general resemblance which the Water-Lilies bear to the Water-Plantains, this fact would lead us to rank the order with Exogens, of which the number five is characteristic, whilst it never presents itself in Endogens. The structure of the seed confirms this conclusion; for the embryo is a little dicotyledonous body, enclosed in a peculiar bag which separates it from the albumen; this bag has been mistaken for a cotyledon, wrapping round the embryo, whose real cotyledons were overlooked; so that the seed has been erroneously considered monocotyledonous.

521. The flower of the White Water-Lily offers many points of interest. It consists of about twenty-five thickish oblong leaves of a white colour, arranged in whorls of five each; the five external ones are green at the back, and may be regarded as forming the calyx; towards the interior of the flower, the petals gradually become smaller, and are tipped with yellow at their points, which are thickened. From these a very gradual transition takes place towards the form of the stamen, as heretofore described (§ 460); and the inner rows of stamens (which are usually altogether about 50 in number) shorten and produce less perfect anthers. The ovary has the lower floral leaves adherent to it, so that the stamens appear to arise from just below the stigmas. It consists of ten or eleven distinct carpels, which adhere closely together their several walls still forming complete partitions in the ovary, each chamber or cell of which contains a large number of ovules. The ovary is surmounted by a number of orange-coloured stigmas, radiating from the centre very much as in the Poppy; but as they are all united at the centre, they are considered as forming but a single pistil; and the plants of this order are therefore arranged, with those of the next, in the Linnæan class and order POLYANDRIA *Monogynia.*

They agree in possessing some bitterness and astringency in their juices; and also in being all floating plants. They are mostly abundant in the northern hemisphere, and have been said to be entirely absent from South America; but a species has been recently discovered there, which in size and splendour far surpasses all others. This is the *Victoria regalis ;* of which the leaf is from 5 to 6 feet in diameter, salver-shaped, with a rim rising from its edge, of from 3 to 5 inches high, green inside and crimson on the exterior. The flower is of proportional dimensions, the expanded calyx sometimes attaining a diameter of 23 inches; this contains several hundred petals, which are at first of a white hue, passing gradually towards pink in the centre, and those nearest it becoming pink throughout. As in the common White Water-Lily, the petals gradually change into stamens towards the interior of the flower; those next the calyx are fleshy and contain air-cells, which must contribute towards the buoyancy of the flower. Their sweet scent enhances its beauty.

522. The small Order FUMARIACEÆ, or *Fumitory* tribe, is chiefly deserving of notice, on account of its containing several British species, of which some are among our most common wild plants. Their flowers are remarkable for only possessing two sepals in the calyx, and four petals which are parallel to each other, the outer one having a little cavity or pocket near its base; they are also remarkable for never completely enclosing, the inner petals remaining adherent at the top, so as to enclose the anthers and stigma. The stamens are six, and are united into two parcels, whence the family belongs to the Linnæan class DIADELPHIA. The ovarium contains but a single cell, being formed by only one carpel, or by the union of two without a partition; and the ovules, which are sometimes single and sometimes numerous, are attached in a horizontal direction. This order, which is principally found in the temperate latitudes of the northern hemisphere, is characterized by no properties worthy of special notice.

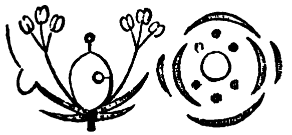


Fig. 70.

Order Papaveraceæ, or Poppy Tribe.

523. The common British species of this order are well known as the plague of the farmer, coming up as rank weeds in his corn field; and another species is important as yielding a product, which, used with discretion, is one of the most valuable medicines we possess, but which by the folly of man, has become the bane of millions If any of the common species of Poppy be examined, they will be found to bear a considerable general resemblance to the Ranunculaceæ. The leaves are much divided, and the stamens are numerous, arising from under the carpels. Unlike the Crow-foot and its allies, however, the carpels are not separate from one another, but are grown together into a single ovarium; no styles are present; and the stigmas are elevated hairy lines, which spread equally from the top of the ovary, forming a sort of star-like crown. If the ovary be opened, it will be found to contain but one cell or cavity; several little partitions, however, project from the sides towards the centre; and these are covered with numerous and very small ovules or young seeds. The common Poppy has a calyx

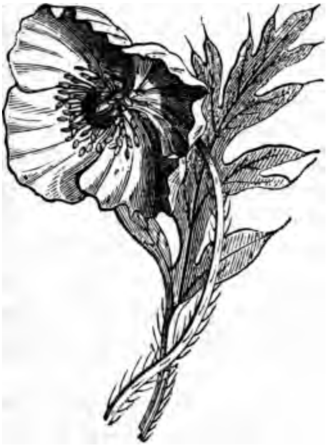


Fig. 71. Leaf and Flower of the Naked-stalked Poppy, exhibiting the four petals, numerous stamens, and single ovary.

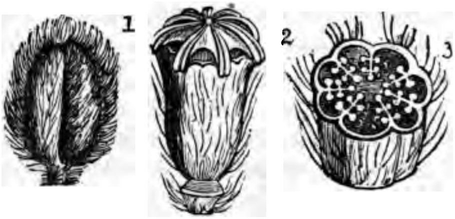


Fig. 72. Parts of the flower enlarged; 1, a flower-bud, showing the two sepals which enclose it; 2, the ovary, with its radiating stigmas; 3, the ovary cut open.

of only two sepals, which completely inclose the bud before it expands; and within this is a corolla of four petals. Some of the tribe, however, possess three sepals and six petals; but the former is the ordinary number. If the stem or leaf of a Poppy be broken, a milky juice runs out; and its whiteness is due to the narcotic substance, *opium*, which is diffused through it; as also, perhaps, to a larger proportion of Caoutchouc than most Vegetable juices contain. The Crowfoot tribe have a clear juice; and this difference, connected as it is with a great difference in the properties of the respective groups of plants, is a very characteristic one. But independently of this, the well-marked difference in the construction of the ovary, takes away all difficulty in distinguishing these two orders from each other.

524. The calyx very early falls off,—a character by which the order may be distinguished from others of less importance. As the ovary ripens, the exterior becomes very hard and brittle, forming a hollow box termed a *capsule*, with a brownish-yellow shell. The seeds, when mature, separate from their attachments, and may be shaken loosely in their case. In this condition, the capsules are well known as Poppy-heads, being kept in druggists' shops, on account of the mild narcotic properties, which give the water in which they have been boiled, some soothing effects when applied as a fomentation. So hard and firm is the shell of the capsule, that the seeds could not find their way out, unless permitted to do so by a particular contrivance. Just beneath the lid, which is firmly bound down to the lower part by the hardened stigmas, there is a set of little valves, which open in the intervals of these (as shown at 2, Fig. 71): and through these the seeds fall out. The structure of the Poppy-capsule is easily understood, by imagining that the several carpels have adhered together, their walls being flattened against each other, just as in the Orange; but that the central portion formed by the union of these has not been developed, so that the partitions are incomplete, though still projecting more from the sides than they do in the Heartsease (§ 434, Fig. 50). In each case, as the seeds are attached to a placenta, which springs from the wall, and not from the centre of

the seed-vessel, the placenta is said to be *parietal.* In the true Poppies, the number of placentæ, marking the number of united carpels, is considerable; but in a British genus *(Glaucium)* commonly known as the Horned Poppy, the ovary is formed of only two carpels grown together; and these, when ripe, look like long slender but stiff horns, whence the common name is derived. The Scientific name is founded on the sea-green hue of the stems and leaves, which look as if the surface had been encrusted with the salt spray. Allied to the Horned Poppy (which grows chiefly on the sea-shore) is a plant termed Celandine *(Chelidonium)*; having pale green leaves and rather small yellow flowers which grow in umbels (as in the tribe of Umbelliferæ hereafter to be described), and frequenting waste places, especially near towns and villages. This still more departs from the ordinary type of the Poppy tribe in the structure of its seed-vessel; which consists of a single pod separating when ripe into two valves, as in the Pea tribe.

525. A very curious anomaly is met with in a foreign genus belonging to this order, the *Eschscholtzia.* The flower of this plant, before it expands, is enclosed in a taper-pointed green sheath, which is pushed off by degrees as the petals unfold, and at last drops to the ground. This extinguisher-like organ would seem to be something entirely new. If carefully examined, however, it is found to be nothing else than the calyx, of which the two sepals have adhered so firmly, that they will not separate, in the ordinary manner, to admit of the expansion of the flower; and as it must be got rid of in some way, nature has provided the means of throwing it off, by making its attachment weak at the base, from which it is disengaged. This adhesion of two parts growing in contact with each other, is a very common occurrence in Plants; and several instances of it will hereafter occur.

526. The plants of this order exhibit, in a greater or less degree, the same tendency to variation which has been noticed in the Ranunculaceæ. This is especially the case with the White Poppy, which is cultivated in gardens on account of the showy appearance of its flowers, when several additional whorls of petals have been developed at the expense of the stamens. Its colour,

also, has a tendency to change, but generally to light shades of yellow and purple. The deep scarlet Poppies, so abundant in corn-fields, are not so prone to variation.

527. All the Papaveraceæ possess narcotic properties in more or less intensity; but these properties are not common to the whole plant, being only manifested by those parts which abound in the milky juice. Thus from the petals of the Red Poppy a syrup is made, which is used, on account of its beautiful deep-red hue, to colour medicines; but this is perfectly destitute of medicinal properties. The seeds, again, yield a large quantity of a fixed oil, which is quite free from any narcotic quality (§ 371). From the ripening capsules, however, especially of the White Poppy, the milky juice may be obtained in large quantities; and it is from this source that all the *opium*, obtained for medicinal and other purposes, is derived. The properties of this drug, and the enormous amount of it consumed, have been already remarked upon (§ 384—5); and the account need not here be repeated. It may be desirable to mention, however, that a syrup is made from the *White* as well as from the *Red* Poppy; and that the former possesses narcotic properties, from which the latter is wholly free. It should be used, therefore, by unprofessional persons with great caution. There is too much reason to believe, that the lives of many infants have been destroyed, by the administration of tea-spoonful after tea-spoonful of White-Poppy Syrup, given by ignorant nurses or mothers, with the idea of temporarily soothing them. And it is also well known, that the injudicious use of many excellent popular medicines, into the composition of which opium enters in unknown quantity (such as Godfrey's cordial, and Daffy's Elixir) has been productive of equally fatal effects. It cannot be too strongly impressed on those who have the management of infants, that they are susceptible of the influence of narcotics in a far higher degree, than to that of purgative and other medicines; so that whilst an infant may safely take a grain of calomel, or three or four of jalap,—one-fifth of the ordinary doses for adults,—a single drop of laudanum is as much as it is

usually safe to give, the dose for an adult being twenty times as much.

528. All the Papaveraceæ belong to the Linnæan Class POLYANDRIA, and to the order *Monagynia;* the style being apparently single, though formed by the union of many.

Order CRUCIFERÆ, or Turnip Tribe.

529. This order is one of the most important to man, in respect to the amount of wholesome food which he directly or indirectly derives from it, of the entire group of Exogens. It comprehends the Turnip, Cabbage, Sea Kale, Mustard, Cress, Radish, and other edible Vegetables; as well as the Rape, cultivated for the oil yielded by its seed; and Stocks and Wallflowers, valued as showy garden-plants. As the flowers are generally small, there might be some difficulty in recognising them; were it not that they are marked by very obvious characters, which are easily observed, and can scarcely be mistaken. One of these characters is the number and arrangement of the stamens; which throughout the whole of this order is scarcely subject to variation, and which is not presented by any plants that do not belong to it. The number of stamens is six; but four of these are longer than the rest; so that they would be characterized in Linnæan classification as *tetradynamous* (§ 483); and in fact the Linnæan class Tetradynamia, and this order Cruciferæ, correspond almost precisely. The arrangement of these stamens somewhat in the form of a Maltese cross, is another peculiarity, from which the name of the order is derived; the four long stamens are placed above and below, and the two shorter ones at the sides. Some other less constant characters will be noticed as we proceed.

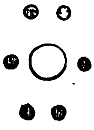
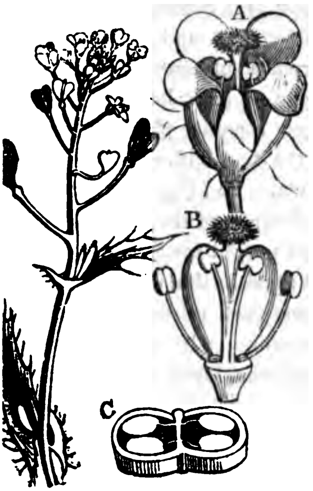


Fig. 73.

530. A good example of this Order will be found in a common weed, named *Shepherd's Purse* (Capsella Bursa pastoris), which may be found almost everywhere, and at all but the coldest seasons



ig. 74. Shepherd's Purse. A, whole
er enlarged; B, stamens and pistil;
orizontal section of ovarium.

of the year. Its name seems to have been derived from its possessing a number of pouches, filled with very small seeds, which might be imagined to be fairy coins. The flowers, in this plant, are arranged upon the stem in the form which is termed a *raceme;* by which it is meant, that they spring from it by short stalks nearly of equal length, which arise at intervals; a bunch of Currants is a very good illustration of this form. It will be observed that they are destitute of bracts; the entire absence of which is a peculiarity of this order; although many genera of other orders are also dis-
guished by it. The calyx is formed of four little sepals; and
hin these are four very small white sepals; the regular arrange-
nt of which increases the cross-like aspect of the flower. The
mens alternate with the petals, and are opposite the sepals.
e pistil is an oval green body, shaped something like a wedge;
the summit of which is a cushion-like stigma, mounted on
extremely short style. If the ovary be cut open, it will be
nd to contain two cells, each of which contains a number of
les hanging by slender thread-like stalks. It will be observed,
wever, that the ovules do not originate from one central placenta,
from one attached to each side-wall of the ovary; and this
lains to us (as will presently appear) the reason why the ovary
very often one-celled in this order and also the peculiar
de of dehiscence of the seed-vessel. The fruit becomes a flat
dge-shaped body, composed of three pieces, two of which,
valves, separate from the third, which is named the *dis-*
iment; and it is to the edges of this third piece that the

seeds are united. Now each valve is a carpellary leaf, the two edges of which are not entirely folded in; and the ovules arise, therefore, from a placenta formed by the thickened edge of each leaf, so that there are really four separate placentæ, as is indicated by the four different directions in which the ovules lie (Fig. 73, C). But the contiguous placentæ of the two carpels unite together, and project towards the middle of the ovarium; and in this instance the opposite ones meet each other, so as to form a complete partition. In many Cruciferous plants, on the other hand, they do not meet; so that the ovary is one-celled, and as the ovules are attached to its sides, the placentæ are said to be parietal. The form of the fruit differs in the different genera of the order; being, as formerly explained in the Linnæan Classification, (§ 483), sometimes, as in the present instance, a short pod or *silicula;* and sometimes a long pod or *siliqua*, as in the Turnip and Cabbage, Stock, and Wall-flower. This distinction is not employed, however, to subdivide the order in the Natural system; since it is not found to bring together the plants that have really the nearest alliance: and Botanists found their classification of the genera (which, on account of their great number, need to be associated in groups) upon certain minute distinctions presented by the embryo. Throughout the order, however, the structure of the seed is different from that which has been elsewhere seen; for it is entirely destitute of albumen; and the embryo is doubled upon itself. (Fig. 74, D).

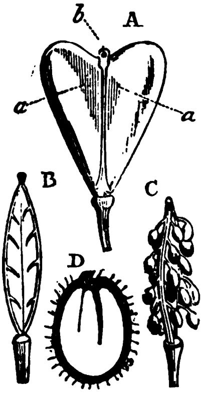


Fig. 75. A, ripe fruit; *a*, *a*, the valves; *b*, the dissepiment. B, dissepiment seen in front, with the marks of the places to which the seeds are attached; C, dissepiment with seeds attached; D, section of seed.

531. All the plants of this order are herbaceous, and most of them are annual. The flowers are usually yellow or white, seldom purple. It is remarkable that, whilst the characters of the order are so constant, those of the individual are liable to such great

variation. This is evident in the species which are cultivated for the beauty of their blossoms, such as the Stock and Wall-flower; as long as the flowers remain single, however, they are not valued by the florist; but it is their tendency to become double, by the development of petals in the place of stamens and pistils, that gives them their richness of appearance. If *all* the organs of fructification, however, were to undergo this conversion, there would be no means of propagating any particular variety or race which it might be desired to perpetuate. But among the petals, a perfect stamen or two will frequently be found; and in another flower an untransformed pistil may present itself; if the stigma of the latter be touched with the pollen of the former, the ovules will be fertilized, and seeds will be produced: these, if placed in a rich soil, will have a tendency to develope flowers of a similar character; but if sown in a barren place, like that which the wild plants inhabit, will probably bear flowers resembling theirs. If, on the other hand, the seeds of a flower departing too widely from the double form, be raised, its flowers will probably be alike imperfect. It is by attention to these rules, that the different races of Turnips, Radishes, &c. have been preserved; whereas if the seeds of those which do not perfectly exhibit the respective characters of the races, had been used for propagating them, they would all have returned in time to their original common form.

532. It is this tendency to variation under the influence of cultivation, that produces the effect valued by the florist in the Stock and Wall-flower, which renders other plants of this order valuable to man as articles of food. There is a remarkable tendency in many of them, to increase the amount of the fleshy portion of their tissues, when abundantly supplied with nourishment. This increase takes place in different parts in different species. Thus in the Turnip and Radish it is chiefly in the root, the natural form of which is often completely changed by cultivation; yet the seeds of any variety of either of these species, if raised in a poor soil, will produce the tough stringy roots characteristic of the original wild plants. In the Cabbage and Sea Kale, it

is chiefly in the stems, leaf-stalks, and leaves; as is also the case in a less degree in the Turnip. The varieties of the Cabbage are very numerous;—the Scotch Kale, the Savoy, the Cauliflower, and Brocoli, are well known forms, departing more or less from the original stock, the *Brassica oleracea* or Sea-colewort, which may be found growing wild on the cliffs near the shores of the greatest part of South Britain, bearing a few small scattered leaves and meagre blossoms. In the Cauliflower, the part most prized as food consists of the flower-stalks, which are enlarged and become succulent under cultivation; when cut for the table, the flowers have not expanded. Some varieties of the Cabbage attain a great size. The palm-kale, which is extensively cultivated in the Channel islands, grows to the height of 10 or 12 feet, the stem being very much elongated and bearing leaves only at its summit, so as to give the plant very much the aspect of a Palm; the inner bud is tender and palatable, and the outer leaves are given as fodder to Cattle. The Tree-kale, or Cæsarean Cow-cabbage, is said to grow to the height of 16 feet, in some parts of France, where it is cultivated for the same purpose.

533. The Sea-Kale is obtained from another marine species, the *Crambe maritima;* the young shoots of which have, time out of mind, been collected by peasants, and eaten as a pot-herb; but which has only within a recent period become a cheap and common vegetable. In order to prevent it from becoming rank, by the too-abundant formation of its peculiar bitter secretion, and stringy, by the production of too many woody bundles, it is necessary to grow it almost in darkness (§ 362); and this is commonly effected by heaping up earth around the young shoots. A species of Brassica nearly allied to the Turnip, is that which furnishes the Rape-seed, from which a large quantity of oil is obtained by pressure; whilst the remaining fleshy substance, known under the name of oil-cake, is a very nutritious food for cattle. In all the seeds of Cruciferæ, there is a tendency to the deposition of a fixed oil in the cells (§ 371); and this deposit is greatly increased by cultivation in the seeds of this and other species.

534. Among other well-known British species of this order

may be mentioned the numerous kinds of Mustard, Cress, Scurvy-grass (of which one species, the *Cochlearia Armoracia* is in common use under the name of Horse-Radish), Pepper-wort, and Lady's Smock, or Bitter Cress. Of this last kind, the common meadow species (Cardamine pratensis) has a considerable tendency to become double; and when its power of reproduction is thus impaired, it has a very curious mode of compensation. The leaflets, whilst still in connexion with the parent plant, will strike root into the ground, wherever they come into contact with it; and from each, a new plant may arise. The *Isatis sativa*, from which the blue dye *woad* is obtained (§ 390), is another native species of this order.

535. The plants of this order are more abundant in Europe than in any other quarter of the globe; and a very large proportion of them are natives of the temperate zones. Their general character is to possess in some degree acrid and stimulating qualities, such as we meet with in the Mustard, Cress, Radish, Horse-Radish, Pepper-wort, &c. When this acrid secretion is dispersed, however, through a large amount of fleshy tissue, as in the Turnip, Cabbage, &c., it does not prevent the plants from being palatable as well as wholesome food. None of this order can be said to be poisonous; and the most of the species it contains are very useful remedies for a most distressing malady, the scurvy, which was formerly not unfrequent in this country, when all but the highest classes fed upon salt meat during the greatest part of the year; and which has been, until late improvements in the provisioning of ships, a most dreadful scourge to the crews of vessels undertaking long voyages. The name *Scurvy-grass*, by which the genus *Cochlearia* is commonly known, shows the estimation in which it was formerly held in this country, as a remedy for this disease; and other species are still more efficacious. There could scarcely, perhaps be mentioned a more striking illustration of the practical utility of which the Natural System may be rendered, than a fact which occurred at the beginning of the last Century. During Lord Anson's voyage round the world, a very large proportion of his crew either lost their lives, or were

rendered unfit for service, by the Scurvy; and although new and unknown lands, teeming with luxurious vegetation, were constantly being discovered, the dread which the surgeon entertained of the men being poisoned, was so great, that he would often allow them to use no other kind of fresh vegetable food than grass. If he had been acquainted with the simple fact, that none of the Cruciferæ are deleterious, and that all possess (in a greater or less degree) those properties which render them more valuable than any ordinary medicines in the treatment of this disease, he might have been able to restore many to health, by simply explaining to them the very evident marks by which this order is characterized, and encouraging them to seek for plants which exhibit such, and to make use of them without apprehension.

536. The Order CISTACEÆ, or Rock-Rose tribe, must next be mentioned. Although not a numerous or very important group, it presents several points of interest. The plants it contains flourish in dry rocky places, where others would not find a due supply of fluid nutriment; and these they ornament with a profusion of blossoms, of brilliant colours, and delicious odour. They usually expand in the night, and after a few hours exposure to the sun, they perish. A few species (belonging to the genus *Helianthemum*) are natives of this country; and others, introduced from the South of Europe, are cultivated as evergreen bushes in shrubberies, or are employed to ornament rough banks and masses of rock-work, over which they trail with great beauty. In the general characters of their flowers, they may be regarded as intermediate between the Papaveraceæ and the Violaceæ, the order to be next described. The sepals of the calyx are five; but these do not exactly form a single regular whorl, as two arise somewhat lower than the others, and are somewhat external to them. The corolla usually consists of five petals, which, from the manner in which they are packed within the bud, have a crumpled appearance when the flower unfolds; they fall off at an early period of flowering, whilst the calyx remains as a protection to the seed-vessel. The stamens are hypogynous, and indefinite in number; and they are usually much shorter than the petals. The ovary is superior, and is either one-

celled with parietal placentæ, or is divided into five or ten cells by partitions radiating towards a centre. There is never more than one style, and this terminates in a simple expanded stigma. The fruit is a capsule, usually separating into five or ten valves; along the middle of each of which there is a placenta, or a partial dissepiment. The seeds contain a small quantity of albumen; and the embryo is very curiously coiled up. All the species, in common with those native to Britain, belong to the Linnæan class POLYANDRIA, order *Monogynia.*

537. This tribe evidently resembles the Poppies, in the transitory character of the flower, as also in the crumpling of the petals; but particularly in having a large number of hypogynous stamens, and a seed vessel partially divided, having numerous seeds arising from parietal placentæ.—But, on the other hand, they are separated by many points of difference; for the calyx of the Papaveraceæ is formed of only two pieces which soon fall off, whilst that of the Cistaceæ is composed of five sepals, and is persistent; the former possesses a milky juice, which the latter do not afford; in the former, there is a large separate albumen, whilst in the latter there is a small one.—Further, they are separated by a peculiar character which is of no small physiological importance. The *foramen* of the seed,—the aperture by which the fertilizing influence is received, and the radicle afterwards makes its way out (§ 436),—is usually situated at the end nearest the placenta; and the pollen-tubes pass into it, by insinuating themselves along the cord which connects the ovule to it. In the Cistaceæ, however, the foramen is situated at the point of the seed; and the manner in which the pollen tubes find their way into it is very curious. When they have reached the top of the ovarium, instead of passing down its sides to the placentæ, they separate themselves into bundles, of which one at once enters each cell of the seed vessel, and spreads through it like a fine cobweb, lengthening until it reaches the apertures of the ovules. The plants of this tribe chiefly abound in the South of Europe and the North of Africa, being scarcely known in Asia and America. They are not known to possess any peculiar properties; a gum-resin termed Labdanum,

which was once used in medicine, is obtained from one species. They are all low shrubs or herbaceous plants.

538. The next tribe which will be noticed is also a small one, mostly composed of still humbler plants, but containing some well-known species of general interest. This is the order **Violaceæ**, or Violet tribe, the largest of the British species of which is the common *Pansy* or *Heart's Ease;* this will be convenient, therefore, to describe in illustration: On looking at the leaves, they will be found to be rather small, and to arise by long stalks, at the base of which are a pair of large stipules; these are very characteristic of the order. The flower consists of five narrow sepals, some much larger than the rest; which are usually prolonged in a curious manner at the base. The corolla consists of five petals, of which, in the Pansy and most other species, two stand nearly erect, so as to appear above the others. These two in the Pansy are differently-coloured; and a third, standing in front of them, has a short horn or spur at its base. The stamens are also five in number, and generally of irregular form, possessing no proper filament, but having a membranous expansion in place of it, which is elongated above the anthers; two of them, in the Pansy, have long projections, which are hidden in the horn of the petal, The anthers are often coherent to each other, and lie close upon the ovary. The ovarium is superior, and contains but one cell; it possesses, however, three parietal placentæ (Fig. 50. p. 268), to which many ovules are usually attached. There is but a single style; and the stigma is covered with a kind of hood, so that access can only be gained to it by an aperture on one side. For this singular conformation, no use has been assigned. When the fruit is ripe, it is still surrounded by the calyx; it is an oblong shining case, which splits into three valves, having the seeds adherent to the middle of each. The Heart's-Ease of the gardens has been greatly improved in its beauty as a flower by cultivation; and a number of varieties, differing chiefly in their colours, are known to florists. The common Sweet Violet has no rival among flowers, if we seek for delicate fragrance; and this is not improved by cultivation.

539. This order is readily known from all other hypogynous Exogens, by its persistent calyx, its irregular flowers, and by the three narrow parietal placentæ situated in the middle of the same number of valves. In the persistence of the calyx, the prevalence of the number 5 in the flowers, and in the slight division of the ovary, it is evidently allied to the Cistaceæ. Of the plants contained in it, few are natives of Asia; and those which inhabit South America differ from the rest in being shrubby instead of herbaceous. The roots of all the Violaceæ appear to be more or less emetic; and those of South America are particularly so, and are used in medicine under the same circumstances as those in which Ipecacuanha is employed in this country.

540. Nearly allied to the violets is the little order **Droseraceæ**, or *Sun-dew* tribe; so named from the peculiar appearance (presently to be described) of the British species, by which it may be illustrated. The little *Sun-Dew* is a plant whose home is in fens and morasses, where it takes possession of little hillocks elevated above the surrounding waters; and it cannot be made to flourish, if transplanted into any other situation. The leaves of this little plant are the most conspicuous part of it, whilst the fructification is the least so. When spread out, they form small concave disks, covered with long shining red hairs, that secrete from their point a clear fluid, which gives the leaves the appearance of being covered with dew-drops. This secretion is most abundant when the sun is at its highest, whilst real dew is only seen on leaves in the early morning; and it is from this circumstance, as well as from the peculiar sparkling appearance of the surface, that the name of the plant is derived. The hairs, when examined with a high magnifying power, are extremely beautiful microscopic objects; they are seen to consist of an immense number of minute cells, arranged with great regularity; and if illuminated by a strong reflected light, the rays from below being cut off, they exhibit a most gorgeous variety of brilliant colours. The fluid secreted from their points has a slightly acrid taste, and it appears to retain insects which settle upon it. The hairs themselves exhibit a considerable degree of irritability; slowly curving

inwards, and entrapping any unfortunate victim that may have come within their reach. This irritability is manifested to a much greater degree in the *Dionæa*, (§ 246) which is an American species of this order; and it is common, in a greater or less degree, to the other known species of it. The organs of fructification are nearly allied to those of the Violaceæ. The flower is regular, however; the stamens have the usual form, and are sometimes double or triple the number of the petals; and the ovary bears from three to five styles. The order is also peculiar as to the manner in which its leaves and flowers are folded together before their expansion. Instead of being simply compressed into buds, they are coiled in a spiral; so that, when unfolding, the leaf-stalks and flower-stalks somewhat resemble a shepherd's crook. This form of development is the same as may be readily observed in the unfolding leaves of the young Fern. (See the highest leaves in Fig 2, p. 27).

541. Passing over several Orders which contain but few species, and these of little general interest, we stop for a short time at one which contains many well-known British plants,—the CARYOPHYLLEÆ, or Chickweed tribe. These are natives principally of the temperate and frigid parts of the world, where they inhabit mountains, hedges, and waste places. Those which are found within the tropics are usually natives of elevated or mountainous tracts, almost always reaching the limits of eternal snow, where many of them exclusively vegetate. The greater part of them are regarded as mere weeds; but some of them are greatly improved by cultivation, and become handsome garden plants, which are greatly valued. Such are the Clove-Pinks, Carnations, and Picotees, which are all varieties of one species, the *Dianthus Caryophyllus*, that naturally grows about old walls, especially on the ruins of ancient castles. The structure of the flower may be best understood from some of the larger species, such as the common Pink; taking care, however, not to choose a double one. It is interesting to remark that whilst in this plant, the leaves—being long and narrow, with only a single vein running from one end to the other—do not afford any characters by which

it might be known as an Exogen, the petals (which are but differently-developed leaves) have a beautiful system of veins, which are evidently reticulated. The stems are very much swollen at the points from which the leaves arise; and this is a character which marks the whole order. The calyx is a tube composed of five sepals united together, and separated only at their points. Five petals arise from within them, of which the lower ends are very narrow, whilst the upper ends are greatly expanded, and are irregularly jagged at their borders. The stamens are ten in number, with short stalks. The ovary is one-celled; and in its centre is a column, round which a great many ovules are clustered. In the Pink there are two styles, each terminating gradually in a narrow fringed stigma; in other species there are three, and in others five styles. The first becomes a dry capsule, opening from the point by four valves. The structure of the seed is variable.

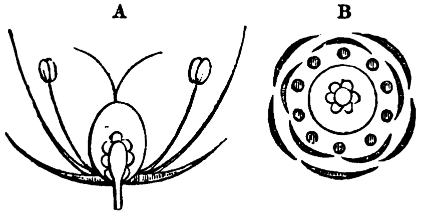


Fig. 76. Diagram of the flower of Caryophylleæ. A, vertical section. B, horizontal section.

542. This order may be distinguished from all other polypetalous Exogens, by the possession of opposite undivided leaves without stipules, and by the tumefaction of the stem at the nodes; it is further separated from others having the same number of stamens, by the structure of the ovarium. This is one of the orders in which a certain amount of variation occurs in the number of the parts of the flower; which are sometimes arranged on the *quaternary* type, or in *fours*,—sometimes on the *quinary*, or in fives. The stamens are always twice as numerous as the petals. Hence, while most species of this order are comprehended in the Linnæan class DECANDRIA, a few fall into Octandria; they of course belong to the orders *Digynia*, *Trigynia*, and *Pentagynia*, according to the number of their styles. The order is divided, in the natural arrangement, according to the adhesion or separation of the sepals of the calyx. The division in which the calyx is tubular contains

with the Pink. the *Silene* or Catchfly, named from often secreting a viscid matter in which flies are caught; the Cockle (*Agrostemma*), which is often a very troublesome weed in corn-fields; the Ragged Robin (*Lychnis flos-cuculi*) frequent in meadows; and the Batchelors' Buttons (*L. dioica*), which is an exception to the general rule, in being diœcious. The second division, which has the sepals distinct, contains the numerous species of common Chickweed or Stitchwort (*Stellaria*), the Mouse-ear Chickweed (*Cerastium*), of which some species are peculiar to Alpine districts, whilst another is aquatic, and the Sandwort (*Arenaria*), so named from the character of the soil in which most of its species flourish best, though some of them are only found in rocky and mountainous places. In regard to the properties of this order there is little to be said. The species belonging to it are in general both insipid and inodorous. Many of the wild species seem to be sought as favourite articles of food by small animals, and some have been cultivated as fodder for cows, the quantity of whose milk they are said to increase.

543. The succeeding order is one which contains but a small number of genera; but these are distributed over the whole world, and afford a product of the greatest importance to man. This is the order LINACEÆ. or Flax tribe, which was once associated with the last order, but differs from it in so many important characters, that it is separated with complete propriety. In the first place, the stems of the *Flax* are not swollen at the nodes, and the leaves are usually not opposite. The sepals of the calyx, which are always distinct, are not arranged in a continuous whorl; but two are external, partly overlapping the others, which are internal; this arrangement, which is termed *imbricated*, is quite different from that which we have seen in the Chick-weed tribe. The two outer sepals are marked *

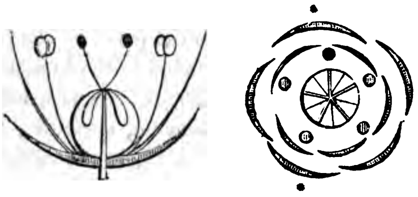


Fig. 77. Diagram of the parts of the flower in the order Linaceæ.

in the diagram. The whole number is generally five, sometimes four. The petals are always equal in number to the sepals. The stamens are equal in number to the petals, and are united at the base into a downy cup; the edge of this exhibits, between the stamens, a corresponding number of little teeth, which are the abortive rudiments of another whorl (§ 465). Within these is the ovary, which appears to contain ten cells, in each of which is a single pendulous ovule; but the number of real cells is only five (in some species four), of which each is partly divided into two by an imperfect partition, extending inwards from its outer wall. Such a partition is termed a *spurious* dissepiment. The ovary bears five (or four) styles and stigmas; and finally the seed-vessel splits into ten valves. By all these strongly marked differences, the real affinity of the Linaceæ to the Caryophylleæ is rendered very small.

544. There is scarcely any plant which is less affected than the common Flax, by differences of soil and climate; and accordingly one species, with all its characteristics unaltered, flourishes in the cold as well as the temperate regions of Europe, in North and South America, in Africa, and in Asia. There are few plants which are made subservient to so great a variety of uses; from which circumstance it is, that this species of *Linum* has received its specific name *usitatissimum*, which means "in most common use." It is from the woody fibre of its stem, that all the *thread* is obtained, which has been from very early ages employed in making *linen* fabrics (the name of which is derived from that of the genus); and it is now used for this purpose to a greater extent than ever, in spite of the degree in which it has been superseded by cotton. The seeds contain a large quantity of oil, which is readily obtained from them by pressure, and is known under the name of linseed oil (§ 371); and the oil-cake which is left is an excellent food for cattle. The seed-coats also contain a large quantity of mucilage; so that an infusion of the seeds, known as linseed-tea, is frequently of great utility as an external soothing application, and is sometimes a very useful internal remedy. Further, the seeds, when ground into a meal, form the

most advantageous material for large poultices; and an enormous quantity is consumed for this purpose, especially in hospitals. The plant, however, is not much cultivated in Britain, notwithstanding various inducements held out by the legislature; for its crops are of inferior value to corn; and it is found to render the soil more unfit for the subsequent growth of other crops, than does almost any other cultivated vegetable. The principal supplies required for British manufacture are drawn from Russia, the Netherlands, and Prussia; some is also brought from France and Egypt, and even from New South Wales. The annual imports vary from 40,000 to 75,000 tons of flax; and about two million bushels of linseed. Flax is grown, however, in Lincolnshire, Somersetshire, and Yorkshire, to a small extent; it is more cultivated in Scotland; and nearly all that is required for the extensive linen factories of Ireland is the produce of that country.

545. The common Flax-plant is an annual, which shoots forth slender upright hollow stalks, about the thickness of a crow-quill. These are surrounded by a fibrous bark or rind, containing woody bundles intermixed with cellular tissue. When the plant has attained the length of about 2½ or 3 feet, it divides into slender flower-stalks; but there is a considerable difference in the dimensions of the stem, according to the soil, season, &c. This difference governs the treatment of the plant; for, if the stem be short and disposed to branch, the plant is considered more valuable for its seed than for its fibrous bark, and is not gathered until its seeds are fully matured; whilst, if the stem grows long and straight, all care of the seed becomes a secondary consideration, and the flax is pulled at the most favourable period for obtaining good fibres, which is a little after the withering of the blossom, before the seeds are quite ripe. The Dutch are accustomed to lay up the plants in stacks, as soon as they have pulled them; experience having shown that, in most instances, seed will ripen after the parent-plant has been pulled, provided that it be not detached from it, being supplied by the sap which it contains; and thus both good flax and seeds may be obtained from the

e crop. The stems are freed from the leaves and seed-vessels process called *rippling;* which means passing them through rt of comb with long teeth, by which these parts are torn off. flax is then placed in water, to dissolve the gummy sap, by ch the bark adheres to the woody portion of the stalk, and to ur the decomposition of the soft cellular tissue by which the dy bundles are held together. This process, which is called *er-retting*, renders the water offensive, and is said to be ealthy to the neighbourhood; and an act preventing its being ied on in any common stream or pond, is in force in this ntry. The length of time required varies from about 10 to 15 s, according to the state of the flax, the temperature of the er, &c. It has been recommended as a much better method, steep the flax in hot water for a short time, with soft soap. water-retting of fine flax, for the manufacture of the most cate cambrics and muslins, is attended to with great care; it articularly necessary that there should be a constant renewal he water, as the fibres will otherwise acquire a dark tinge, of ch it will be almost impossible to get rid by bleaching. The ous bundles are then separated from the rest of the tissue, by ng passed between two surfaces, one of which has grooves, which enter projecting ridges on the other. In former times, in some countries at the present, a very simple machine is l for this purpose, termed a *break;* this consists of two long ks, cut in the manner just described, united by a hinge at one ; the lower one being supported, the upper is lifted at the er end by the right hand, and the stems are drawn with the between the two jaws of the break, which are made to close ether forcibly several times, so as to bruise the stems and arate their parts from each other, without breaking the fibres. er this another operation is required, to separate the smaller ticles of bruised refuse from the flax; this is termed *scutching.* se two operations are now usually performed together by a hine, principally consisting of three cylinders with ridges and entations that work into each other; and between these the is passed. After this, the flax is *heckled*, by drawing the bundles through a frame studded with rows of sharp pins; this effectually frees it from all extraneous matter, and presents a series of smooth distinct filaments. It is then ready for the spinner. The finer kinds of flax, however, are prepared in a more delicate manner; being merely scraped or cleansed with a blunt knife on a soft skin of leather, and afterwards dressed with a kind of brush. Machine-spinning has now almost superseded hand-spinning in this country; but the finest thread can be produced by the latter process. By machinery a thread measuring 12,000 yards has been spun from one pound of flax; but by hand-spinning a thread of three times that length has been produced from the same weight.

546. The only other species of this order, which is cultivated for the same purpose, is the Siberian perennial flax. This is a much taller plant, having coarser fibres; these are found to be very strong, but not so white or fine as those obtained from the common flax. They serve very well, however, for the manufacture of coarse fabrics; and there is this advantage attending the cultivation of them,—that from the same root, a succession of stalks will be developed for many years; so that they require no further attention than to be kept free from weeds. The juices of all the plants of this order seem to have a purgative quality; this is very slight in the common Flax, but is greater in the common *L. catharticum* or Purging-flax of this country, as well as in some foreign species.

Order MALVACEÆ, or Mallow Tribe.

547. Almost every child is familiar with the *cheeses* that he finds among the hedges; and there is not a civilized human being who does not make great use of *cotton* fabrics; yet few, save professed Botanists, are aware how close a relation there is between the humble neglected plant that bears the former, and the cherished exotic shrub to which we are indebted for the latter. They both belong to the same order, which is marked by characters that readily distinguish it, and which may be explained from the

common British Mallows as well as from any other of the more highly-prized species. Of the former there are two kinds, one bearing small pink blossoms, the other large purple ones, which are among our handsomest wild flowers. The latter, which may be best chosen for examination, grows two or even three feet high, in places where it is not cropped by cattle; its stem is covered with longish hairs, which frequently spring in stellate (star-shaped) clusters; its leaves are roundish, slightly divided at their edges, and possess small scale-like stipules at the base of their petioles. The sepals are five and are placed in an uniform whorl; they are partly adherent; and on the exterior they have three bracts, arranged as almost to resemble an additional calyx. The petals are also five; previously to their expansion they are folded together in a very curiously-contorted manner. The stamens are numerous; and their filaments adhere at their lower part, so as to form a tube which embraces the pistil. This structure is exactly what is termed, in the language of the Linnæan classification, *monadelphous;* and the whole of this order, therefore, belongs to the Linnæan class Monadelphia. The anthers only possess one lobe, which opens transversely. The pistil is composed of several united carpels, each of which has its own style arising from its summit; the styles, like the stamens, are united at their lower part into a tube. The seed-vessel is divided by complete partitions into numerous cells, each of which contains one or two ovules; and when cut across in its unripe condition, the ovarium exhibits a very beautiful aspect, from the regularity of the arrangement of its contents. When ripe the carpels readily separate. All the characters now enumerated, with the exception of the number of sepals and petals, which varies from three to five in each whorl, are common to nearly the whole order.

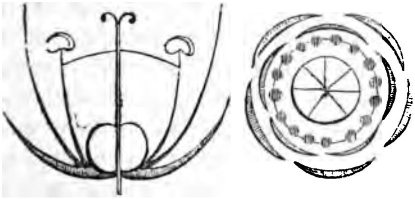


Fig. 78. Diagram of the flower of Malvaceæ.

548. The British species are not numerous; they consist of

three of the genus *Malva*, or ordinary Mallow, two of the *Althæa* or Marsh-mallow, and one of the *Lavatera* or Tree-mallow, so called from its higher growth. These are remarkable for little else than the quantity of thick transparent mucilage, which almost all the green parts yield; and on this account they are thought to afford useful remedies in some pectoral complaints. They do not possess, however, any active properties. It is between the tropics, that the most remarkable species of Malvaceæ abound; and this seems to be the natural habitation of the Order, since the proportional number of species belonging to it in any country, diminishes rapidly as we pass from the Equator to the Poles. The showy Hollyocks, now naturalized in our gardens, are species of Malvaceæ introduced from a warmer climate. The genus *Hibiscus* is remarkable for the striking aspect of its flowers, which are much cultivated in hot-houses in this country; their stems contain strong and tough fibres, which have been used as a substitute for flax and hemp in making cordage. (It is said that whips, formerly employed by slave-drivers in the West Indies, were made of the platted fibres of this plant.) The unripe fruit of one species of Hibiscus, known in the East and West Indies under the name of Ochro (in some places Gobbo), is used, on account of the abundance of its mucilage, to thicken soups. Other species of this genus contain a powerful colouring principle, which gives a black stain to anything which it touches; and the leaves of a species of Althæa are said to yield a blue colour not much inferior to indigo.

549. Of all the genera of this order, however, there is none so important to man as that which yields Cotton; and it may be questioned if there is any other single tribe, except the Grasses, with which he would now find it more difficult to dispense. Cotton is derived from several species of *Gossypium*, which are cultivated in both the Old and New World; of no part of Europe, however, are any of these species natives, though cotton has been cultivated in the southern parts of Spain and Italy. There is much uncertainty as to the real number of species; as the genus is one in which there is a great tendency to the production of

varieties. It is desirable, however, that their respective characters should be well ascertained; since the differences in their produce make the knowledge of them of great importance to the cotton-planter, as they vary greatly both in the quantity and quality of their produce. Some yield their downy harvest twice in the year; others only once. Some bear cotton of a long and delicate fibre, and of a beautiful whiteness; whilst the fibres of others are short, coarse, and of a bad colour. These differences are strongly marked in the cotton imported from different countries; thus the American cotton fetches a much higher price in the market than the Indian; and, though it cannot be questioned that the soil, climate, and care in gathering, have a considerable influence on the goodness of the article, yet it is also as certain that great improvements might be effected, by replacing inferior species by others of more value. This is now being attempted in India.

550. The fibres of Cotton are obtained from the seed-vessel, in which they are packed round the seeds; and no further trouble is necessary to obtain them, than to withdraw them when the capsule bursts. This should be done as early as possible: since exposure to the sun gives a yellow tinge to the cotton. These fibres do not consist, like those of flax, of woody tubes; but they are composed of cellular tissue; and they are consequently much weaker in proportion to their diameter. The greatest difficulty in the gathering of cotton, consists in the separation of its fibres from the seeds they enclose, to which they sometimes adhere with great tenacity; the firmness of this adhesion varies in different species; and *that* is to be preferred, therefore, in which the cotton is most readily freed. In the greater part of India, the use of machinery for this purpose is unknown; and the cotton is cleansed by hand; in America, however, large machines are employed, which accomplish it very rapidly and effectually. A species of Gossypium cultivated in China is remarkable as having naturally a coloured fibre; it is from this that the *Nankeen* cotton stuffs are made, which were at one time commonly worn in this country, and the name of which was derived from that of the place where alone they were manufactured.

551. Notwithstanding the enormous amount of raw Cotton now imported into this country for the supply of its manufactories, the employment of it in Britain, to any considerable extent, is comparatively recent. In the 17th century, the trifling supply required was obtained wholly from Smyrna and Cyprus. In the year 1786, about 20 million pounds were imported; of which about a quarter was from Smyrna, &c. another quarter from the British West Indies, and the remainder from other colonies. Shortly after that period, when machines for spinning cotton-yarn were devised by Arkwright and others, the annual consumption of cotton increased six-fold, and it has been progressively augmenting ever since. From all quarters of the world does the raw material now flow in upon us; and it is converted, with an expedition scarcely credible, into textures, of which a large part are re-conveyed to the countries which originally furnished it. In the year 1838, the quantity imported was upwards of 500 millions of pounds; whilst of this there was exported in the form of wove stuffs nearly 700 million yards, and of twist and yarn about 115 million pounds; the value of which, together with that of the cotton hosiery and small wares exported, would amount to about twenty-four millions sterling. When machinery was first introduced, it was made capable of spinning a pound of cotton into yarn 160 miles long; and a much greater degree of fineness may now be attained. The hand-spinners and weavers in India far outdo machinery in the delicacy of their fabrics, some of their muslins being expressively termed "woven air;" but so great is the saving effected by machinery, in the production of all cotton fabrics but such as these, that a large proportion of those used in India are exported from Britain; it being a saving of expense to cause the materials thus to undergo the double voyage, although labour is so extremely cheap in India.

552. Nearly allied to the order Malvaceæ, which contains few save herbaceous or shrubby plants, is the order BOMBACEÆ, or Silk-cotton tribe, none of which are herbaceous, whilst some species are amongst the most remarkable examples of arboreal vegetation, such as the celebrated *Baobab* trees of Senegal (§ 129).

One of the trunks of this species has been found to be of the enormous girth of from 90 to 100 feet; the spread of the branches and roots is enormous; one main root, uncovered by a stream, having been traced to 100 feet from the stem, and probably extending much further. The height of the trunks, however, does not bear the usual proportion to their thickness, being in general but little more than their diameter. In the interior parts of Africa, at a distance from rivers, the trunks of these trees are converted by the natives into tanks, their heads being cut off, and their immense bodies hollowed out for the reception of water, which, in consequence of the softness and lightness of the wood, is not a difficult task. On the eastern coast of Africa, this tree is very liable to be attacked by fungi, which prey upon its heart-wood, and, without changing its general appearance, destroy the life of the tree, and render the timber very soft. Such trees are hollowed out by the natives as burial places for the bodies of those who are supposed to hold communion with evil spirits; and these, being suspended in the chambers thus constructed, become dry, and are well preserved like mummies. The bark of the Baobab yields a coarse thread, of which ropes and cloths are made; and its fruit contains a mealy pulp around the seeds, which forms a wholesome and agreeable article of food.

553. The species yielding the Silk-Cotton of South America is also a large tree having a light wood; this is frequently employed for making canoes, and a single trunk has been known thus to hold 150 men, or 25 tons of sugar. The tree derives its name (*Bombax*, the same as that of the Silkworm,) from the peculiarly silky character of the hairs, which surround the seeds, in the same manner as the wool of the Cotton. This wool is commonly used to stuff cushions and beds; and lint and a sort of felt has been made from it; but it cannot be spun into threads, in consequence, it is believed, of the absence of the minute roughnesses, which exist upon the surface of the true Cotton fibres, and which are very important in binding them together. The difference between the Bombaceæ and the Malvaceæ, in any other respect than their size, is not great. The calyx of the former

is not exactly valvate; the tube formed by the adhesion of the stamens is cleft at its upper part into five divisions; and the anthers, which, like those of the Malvaceæ are one-celled, burst longitudinally instead of transversely. They resemble Malvaceæ also in the mucilaginous character of their juices, and in the entire absence of any deleterious properties. They are all natives of tropical climates.

554. Another order nearly allied to the Malvaceæ, is that of **Bromaceæ** (the Byttneriaceæ of De Candolle) or *Cacao* tribe. They are usually shrubs or trees, which are, like those of the last order, confined to tropical regions and countries bordering on them. They have no very obvious differences from the Malvaceæ, except that the petals are often absent, and that the anthers are two-celled, bursting longitudinally. The stamens are variously united, but usually form a single tube; not unfrequently many of them are abortive; and, as in the Cacao itself, they assume the form of narrow petals intermediate between the true stamens. The carpels are less numerous than those of the Malvaceæ, varying from three to five; and the number of ovules in each cell is usually much greater. Like the Malvaceæ, these plants are remarkable for the quantity of mucilage they contain; and it is from one species that the Gum Tragacanth, so much used in the arts (§ 380), is obtained. In a few species, the juices possess a slight acridity; and in others some astringency.

555. The order is chiefly interesting on account of the importance of the genus *Theobroma Cacao*, in yielding the material of a wholesome and nutritious beverage, the occasional use of which in this country gives but a slight idea of the large quantity consumed in many others. It is a little curious that, whilst the generic name, signifying "food for the gods" was given to it by Linnæus, on account of his high estimation of its qualities, a traveller of the sixteenth century declared that chocolate was a drink "fitter for a pig than for a man." The Cacao tree rises usually to the height of about 20 feet, though sometimes it attains an elevation of 30 or 40 feet; its leaves are large, oblong, and pointed; whilst its flowers are small, and of a pale red. The calyx consists of

five sepals of a deep red; and within these is a corolla formed of five petals, the form of which is peculiar. They are broad and channeled into a sort of gutter at their lower part; in the middle they are extremely narrowed; and they expand again towards the summit, at which they adhere. The stamens form a tube, on the upper end of which the five that bear anthers alternate with the other five that have a narrow petalline form; and the latter, in the complete flower, are seen projecting above the ring formed by the adhesion or the top of the petals. The pistil is formed on the same general plan as in the Malvaceæ, consisting of five adherent carpels, each of which has its own style and separate stigma; but the ovules are numerous, varying from 20 to 100 in the whole capsule.

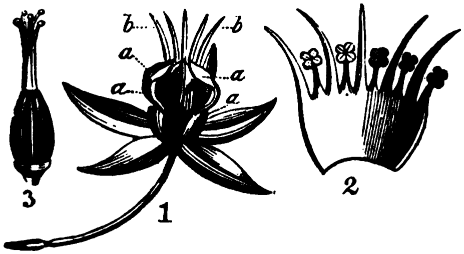


Fig. 79. Flower of Theobroma Cacao. 1, Complete flower; *a*, *a*, the petals; *b*, *b*, the petal-like stamens: 2, the tube formed by the adhesion of the stamens, cut open, showing the five true stamens alternating with five abortive: 3, pistil, with a single style composed of five adherent, and surmounted by five separate stigmas.

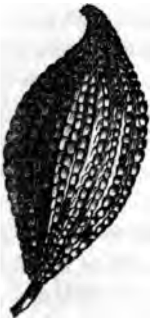


Fig. 80. Fruit or Capsule of Cacao-plant, containing the seeds or nuts.

556. The fruit, when ripe, is a long oval, of which the surface is covered with rounded eminences, and is marked by ten furrows; its interior cavity is simple, in consequence of the obliteration of the original partitions; and the seeds are grouped round a central column. They are imbedded in a sort of mealy pulp, which, although sweetish, has a disagreeable flavour. This pulp is sometimes removed from the seeds by washing, after which they are dried in the sun; and sometimes, in order to get rid of it, they are buried in the soil, until it is detached by decomposition. The seeds are then prepared by roasting, after which their hard husks are easily detached; and the fleshy interior is beaten up into a smooth

paste, which is afterwards dried. Chocolate differs from cacao simply in the addition of various spices and flavouring ingredients. It is much more employed in France than in England, and is commonly drunk for breakfast in Spain. In Mexico, it is considered an article of prime necessity; and it was extensively cultivated there, at the time of the Spanish invasion of South America. Humboldt, the celebrated traveller, remarks, that it is by chocolate and maize-flour, that man has been enabled to penetrate the vast uninhabited forests of central America, and to gain access to the stupendous table lands of the Andes. The seeds were employed as coins, in order to express values below sixpence, which was that of the smallest metal coin, six of them being about equivalent to a halfpenny; and this use of them is still partially continued. A kind of buttery substance may be extracted from the seeds of the Cacao, which is said to have a very bland and agreeable flavour, and to serve as an excellent emollient application to the skin; whence it is highly prized, in some countries, as an ingredient in ointments and cosmetics. It was estimated that, in 1806, about 23 million pounds of Cacac was imported into Europe from South America, Mexico, and the West Indian islands; of this quantity the greater part was consumed in Spain. The quantity consumed in Britain in the year 1831 was not more than half a million of pounds, but in that year the duty was lowered from sixpence to twopence a pound; the consumption immediately doubled, and it is now a million and a half pounds annually. A large quantity is employed in the British navy and merchant-service, as a partial or entire substitute for ardent spirits; and it may be expected that the rapidly-increasing disuse of the latter most injurious liquors, will occasion a still further demand for this wholesome and nutritious article.

557. The order TILIACEÆ, or *Linden* tribe, is also nearly allied to Malvaceæ. The principal part of this order consists of herbaceous plants, with handsome flowers, which abound within the tropics; some species, however, are lofty trees; and these, contrary to the general rule, are natives of temperate regions. Three species of Linden or Lime-tree are found in Britain; of which the largest

and best known is probably not a native of this country. This last sometimes grows to a great size; and its wood, being light, soft, smooth, close-grained, and not liable to be worm-eaten, is valued by carvers for ornamental works, and also forms one of the best kinds of charcoal for the manufacture of gunpowder. Its flowers are very fragrant, and are a favourite resort of bees, who obtain from them not only honey but a large supply of pollen, which they store up for the nourishment of their young; and if a hive of bees is at no great distance from a grove of limes, it may be known when these are in flower, by the large number of bees that will return laden with little pellets of the bright yellow pollen which these blossoms furnish. There are perhaps no trees which form so beautiful an avenue,—the peculiar mode in which the branches arise from the stem and meet above, giving them very much the aspect of the Gothic columns and arches of a cathedral; and when the lover of Nature walks beneath their luxuriant foliage, "at dewy eve distilling odours," he feels them to constitute a fit temple for the worship of Nature's God.

558. The characters by which this order is distinguished are such as to show its near alliance with the Malvaceæ. The calyx consists of 4 or 5 valvular sepals; and the corolla of an equal number of petals, which are rarely wanting. The stamens are indefinite in number, and not united into a tube; and the anthers are two-celled, bursting longitudinally. The pistil is formed of 8 or 10 united carpels, having a single style, and stigmata equal in number to the carpels, as in the Bromaceæ. The partitions are permanent, so as to divide the fruit into cells. They are at once known from the Malvaceæ and two succeeding orders, by the non-adhesion of the stamens; and from the Malvaceæ and Bombaceæ by their two-celled anthers. In their general properties, the Tiliaceæ resemble the Malvaceæ; they are quite harmless, and contain a considerable quantity of mucilage. The sap of the Lime abounds in saccharine matter, from which a good sugar has been extracted, and a pleasant wine obtained by fermentation; and its nuts are said to possess, when roasted, something of the flavour of chocolate. The bark of most species of the order is tough and

strong, and easily separable into layers; and from these, mats, baskets, and cords are made in many countries.

The small order DIPTEROCARPEÆ, nearly allied to this, is worthy of notice, on account of its containing the Camphor-tree of Sumatra, from which our chief supplies of camphor (§ 383) will probably hereafter be obtained, though they are at present derived mostly from a species of Laurel. This product is stored up in the former, in receptacles (§ 98) sometimes a foot and a half long; but the tree must be deeply cut into, in order to open these. Some other trees of this group (which is entirely confined to tropical climates) afford small quantities of resin; and it is from one of these that the Piney tallow (§ 382) is obtained.

559. The next order to be particularly noticed is one of special interest, from its furnishing a product which, without being in the least nutritious, is considered by the Englishman, in almost all ranks, as one of the most indispensable articles of his diet. This order is that of CAMELLIACEÆ, the *Camellia* tribe, well known to the Horticulturist for the beauty of its flowers; and it is from various species included in it that *Tea* is obtained. The *Camellia*, now cultivated in most gardens, will afford a good illustration of the characters of the order, which approach those of the succeeding one. The calyx is composed of from 5 to 7 sepals, unequal in size, of rather tough consistence, and in some degree overlapping each other. The petals are from 5 to 9, also occasionally imbricated, and sometimes slightly adherent at the base. The number of stamens is indefinite; and they are generally united at the base into one or more bundles. The ovarium is formed of from 3 to 6 carpels, more or less united, with separate styles; each cell originally contains several ovules. In the ripe capsule, there are only three cells, each containing but one seed (the other ovules not

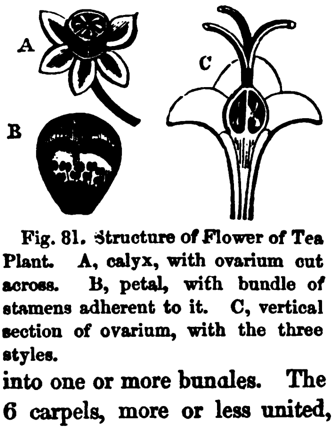


Fig. 81. Structure of Flower of Tea Plant. A, calyx, with ovarium cut across. B, petal, with bundle of stamens adherent to it. C, vertical section of ovarium, with the three styles.

having been developed); and this is large, with fleshy cotyledons that contain a large quantity of oil, and destitute of albumen. The Camelliæ are celebrated for the great beauty of their foliage, and the splendid colours of their blossoms, which vary through every shade and mixture of red and white. The C. Japonica is a lofty tree in its native country; and even in our conservatories it sometimes reaches a considerable size. The leaves of some species of Camellia have been used as Tea; but this is properly derived from the genus Thea.

560. Nothwithstanding the many different kinds of Tea exported from China, there is good reason to believe that they are all the produce of one species; and that the differences of quality are the result of variations in the character of the plant, which are induced by differences of soil, climate, &c. in the extensive tract over which it is grown,—and of variations in the age of the trees, the time of gathering the leaves, and in the mode of preparing them. The tea districts of China extend from about the 27th to the 33d degree of north latitude; but the plant may be cultivated in regions more distant from the equator, if the climate be mild and equable. It delights in shallow soils on the sides of hills; and some of the finer kinds are said to grow on such dangerous declivities as to be inaccessible to man, so that their leaves can only be obtained by the artifice of provoking the monkeys that dwell among them, which, when enraged, break off the boughs, and fling them at their tormentors below. The plant

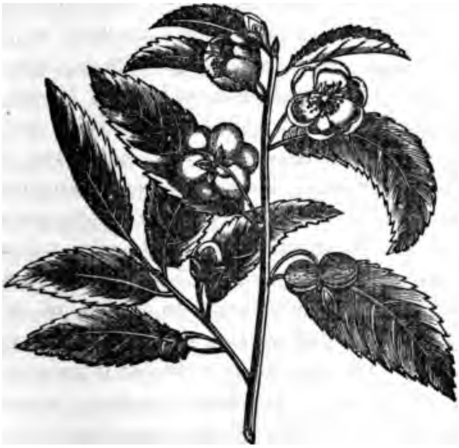


Fig. 82. Tea Plant.

is raised from seed, and the first crop of leaves is gathered in the third year; after the shrubs have attained the age of six or seven years, their produce becomes so inferior that they are removed to make room for a fresh succession. The leaves are gathered from one to four times during the year, according to the age of the tree. Most commonly there are three periods of gathering; the first commences about the middle of April; the second at Midsummer; and the last in August. The leaves that are earliest gathered are of the most delicate colour and most aromatic flavour, with the least portion of either fibre or bitterness; leaves of the second gathering are of a dull green colour and have less valuable qualities than the former; whilst those which are last collected are of a dark green and of inferior value. The quality is further influenced by the age of the wood on which the leaves are borne, and by the degree of exposure to which they have been accustomed; leaves from young wood, and those most exposed, are always the best, as is readily understood on physiological principles. The leaves, when gathered, are partly dried by the air and sun, and partly by artificial heat, and are carefully rolled up by the hand. It is commonly believed that the distinctive character of green tea is imparted to it by being dried upon sheets of copper. For this belief, however, there is no foundation in fact, since copper is not used for the purpose; and the most careful application of chemical tests fails to discover any such impregnation. The Tea-plant has been found growing wild over extensive tracts in Assam, at the north-east of Hindostan; and attempts are now being made to cultivate it there on a large scale, in order to render Britain independent of supplies from China; it must be long, however, ere this can be the case; and it is by no means certain that the Chinese mode of preparing the leaf is exactly followed.

561. The history of commerce does not furnish any parallel to the circumstances which have attended the introduction of Tea into Great Britain. The leaves are said to have been first employed by the Chinese to cover the taste of their water, which is in many districts brackish and unpalatable; and the infusion being found to be pleasant in its flavour, and productive of an agreeable

excitement, the practice of drinking it gradually extended in those places where the water was good, and at length was introduced into Europe. The leaf was first imported by the Dutch East India Company in the early part of the seventeenth century; but it does not appear to have found its way to England until about the year 1650. The first historical notice of it is in an Act of Parliament of the year 1660, in which it was enumerated as one of the beverages sold in coffee-houses, on which a duty was to be laid. That it was not then a common drink, is evident from an entry in the private Journal of Mr. Pepys, Secretary to the Admiralty, who says, Sept. 25, 1661, "I sent for a cup of tea (a China drink,) of which I had never drunk before." In 1664, the British East India Company sent *two pounds* of tea as a present to the King. In 1667 they issued their first order to import tea, directed to their agent at Bantam, to the effect that he should send home 100lbs. of the best tea he could get. Since then, the consumption has gone on regularly increasing. In 1734, the quantity imported was about 632,000 lbs; in 1768, it was nearly seven million pounds; in 1800, it was twenty millions; and during the last four years of the East India Company's charter, the average quantity imported was 31½ millions. Since the abolition of the monopoly, and the consequent reduction of prices, the consumption has increased still more rapidly; the amount imported having in some years nearly reached 50 million pounds, of which above 44 million pounds were consumed in Great Britain and Ireland,—a quantity much exceeding that consumed in all the rest of Europe and America. To provide a sufficient supply of this article, many thousand tons of the finest mercantile navy in the world are annually employed in trading with a people by whose government all dealings with foreigners are discouraged; and an important source of revenue, averaging from three to four millions sterling, is obtained, through a moderate duty upon its importation, by the state.

562. Although the plants of this order which are known in European gardens are chiefly from China or North America, these form but an inconsiderable part of the whole; 7 or 8 species being all that are contained in the first of these countries, and 4

in the latter; while between 60 and 70, all beautiful trees and shrubs, are natives of the woods of South America; and about 20 more are known in the East Indies.

Order AURANTIACEÆ, or Orange tribe.

563. The group of plants producing Oranges, Lemons, Limes, Citrons, Shaddocks, Forbidden-Fruit, and the like, is readily distinguished from the rest of the Vegetable Kingdom, by several evident characters, which give to its structure much interest; and it is also one of great value to man, on account of the large quantity of grateful and refreshing fruit with which it supplies him, in the very climates where it is most needed. It is remarkable as being the only tropical fruit which can be introduced into this country, at a cost little exceeding that of our ordinary native fruits; and whilst it thus offers a gratification within reach of the poorer classes, it is so superior to other fruits, that it cannot be despised for its cheapness even by the richest. From the amount of duty paid upon Oranges, it has been calculated that about 272 millions are annually imported; which gives an average of nearly a dozen to each individual of the population. This abundance is due in part to the prolificness of the tree; a single individual, at St. Michael's, having been known to produce 20,000 oranges fit for packing, exclusive of the damaged fruit and waste, which may be calculated at a third more. It is also due to certain qualities in the fruit itself, which allow it to be kept for a considerable time, with less alteration than fruit of any other kind. Of these qualities, one of the most remarkable consists in the thick spongy rind, which resists changes of temperature by its non-conducting power; and in the large amount of minute oil-receptacles by which the surface is occupied, the contents of which almost entirely prevent the evaporation of the watery fluid within, and by their acridity resist the attacks of insects, &c. from without. Hence internal decay is the only accident by which oranges are liable to be destroyed; and this does not happen for a long time, if the rind remains uninjured, so as completely to exclude the air from the interior,

and if they are well ventilated, and kept free from moisture, which would cause the exterior to decompose.

564. If we examine any plant of the Orange tribe, grown in a hot-house in this country, or in the open air in its native clime, we may at once observe that it has a peculiar aspect, in consequence of the surface of its leaves being covered with minute yellowish dots. These dots are little receptacles for secretion, filled with an essential oil very fragrant to the smell, though acrid to the taste; the leaves possess some fragrance in their natural state, but, if they be crushed between the fingers, this is very much increased, part of the receptacles being then broken into. These little cavities exist not only beneath the surfaces of the leaves and fruit, but also in the leafy parts of the flower, which owes most of its fragrance to them. On further examining the leaves, it will be observed that they are articulated or jointed at the junction of the blade with the petiole, and that the latter is expanded (more or less in the different species) into a sort of small supplementary leaf, by the development of a narrow blade from each side. In some species the leaves are pinnate; and it occasionally happens that the leaflet of one side only is developed, or that even both are absent; so that the petiole, which is then much enlarged, has to perform the functions of the true leaf, as in some other cases (§ 228). The calyx has the shape of a cup, being formed of five sepals (in some species only three) united at their lower portion, and separating above into as many teeth; it early falls off. The petals are equal in number to the sepals; they are sometimes slightly adherent at the base; and in the Orange they are fleshy and white, with dots of green. The stamens are equal in number to the petals, or twice or some multiple of their number; the filaments are rather flattened at the base, and are sometimes adherent into one bundle, sometimes into several, and are sometimes altogether free, as in the Orange itself. The pistil has a nearly globular ovarium composed of several adherent carpels; it bears a thick tapering style having a slightly-divided stigma at its point; and in each cell of the ovary, there is a double row of ovules.

366. During the ripening of the fruit, however, a large proportion of these ovules perish; and in the Orange and its nearest allies, the cavity of the seed-vessel becomes filled up with a pulp consisting of separate vesicles, each containing a portion of the sweet-acid fluid, which is so characteristic of the fruit of this order. The aggregation of these cannot be distinctly seen in the usual state of the common Orange, in consequence of their close adherence to one another; but in an over-ripe orange, or in one grown in a hot-house, they are very easily separable. An important change takes place also in the structure of the carpels themselves, which will serve to illustrate the still more striking alterations that occur elsewhere. It is to be remembered that each carpel may be regarded as composed of the same elements which form a leaf; and that in some carpels, the resemblance to a leaf is very distinct (§ 462). Supposing the two edges of the carpellary leaf to be folded together, as represented in Fig. 60., we should have the cuticle of the under surface becoming the lining of the cavity, the cuticle of the upper surface forming its external wall, and the parenchyma or fleshy tissue of the leaf intervening between them. The amount of this parenchyma is subject to much variation; and the two cuticles often undergo great changes in structure and degree of density. The ovarium of the orange is to be regarded (as already stated) as made up of a considerable number of carpels adherent to each other; and in its early condition, the walls of these are every where of the same firm fleshy character. During the ripening of the fruit, however, the rind or external wall, is separated from the inner wall by a quantity of spongy parenchyma, which in some species (as the Shaddock) attains a very considerable thickness; the outer walls of all the carpels unite together to form one continuous envelope; whilst the inner walls, enclosing the pulp and seeds, are easily separated from this and from each other. In the Plum, Cherry, Peach, and other stone fruits, the change is still more decided. In these, each fruit, which is the ripened ovary, contains but one cell; and each cell usually but a single ovule when mature, though at an earlier period it may have contained several. Now the lining or inner

wall of the ovary here becomes greatly condensed, forming the stone; the outer membrane continues to exist as the cuticle or skin of the fruit; and it is the fleshy part of the carpellary leaf, very much increased in amount, that forms the edible portion. In such instances, the outer is called the *exocarp*, the inner wall or stone the *endocarp*, and the succulent flesh the *sarcocarp*.

566. The various species of the Orange tribe are almost all natives of the East Indies and China, whence they have been transported to other countries within or near the tropics. They nearly all contain sugar, citric acid, an aromatic essential oil, and a bitter principle having tonic properties; but these are combined in varying proportions in different fruit. Thus in the common Orange the sugar prevails, and the acid (when the fruit is ripe) is subordinate. In the Lemon, the acid is always predominant in the pulp, and the oil is more abundant in the rind. In the Shaddock, and still more in the Seville Orange, the bitter principle manifests itself. Various species, unknown in this country, are used as articles of food by the inhabitants of the countries of which they are natives; and from some a valuable timber is derived. The Orange and its allied species require two years to mature their fruit; and, as they continue flowering all through the summer, a healthy tree exhibits, during a considerable part of each year, every stage of the production, from the flower-bud to the ripe fruit, in perfection at the same time. Most of the oranges and lemons intended for transportation to a distance, however, are gathered whilst they are still green; for if the fruit were allowed to become mature, it would spoil in the conveyance. The gathering of oranges and lemons for the British market generally occupies from the beginning of October to the end of December; and they would require to hang until the commencement of the spring, to ripen fully on the tree. It is remarkable that the Orange trees from which the fruit is gathered green, bear plentifully every year; whilst those upon which the fruit is suffered to ripen, afford abundant crops only in alternate years. The Oranges of St. Michael are the best that are known in Europe; but the tree was introduced there by the Portuguese,

as it was by the Spaniards into the New World. The Orange is extensively cultivated in Spain and Portugal, where it was early introduced by the Moors; near Cordova there are trees which are considered to be 600 or 700 years old; and in Andalusia there are extensive orchards which have formed the principal revenue of the monks for ages. In the south-east of France, also, and in the North of Italy, the orange is cultivated with great success; but it does not thrive well in the peninsular part of the latter country, except at the South. Besides the refreshment afforded to man by the cooling fruits and delicious perfume characteristic of this order, it yields him an article of great importance in his manufactures,—lemon juice,—the chief uses of which have been formerly mentioned (§ 402).

567. The next order to be noticed is that of **AMPELIDEÆ**, which is principally important as containing the common Grape vine, which will serve as an illustration of its characteristic structure. Nearly all the plants of the group are climbers, and most of them support themselves by *tendrils*. The nature of these organs differs, in almost every tribe of plants which possesses them. If the Pea be examined, its tendrils will be seen to consist in a prolongation of the midrib or central stalk, from each side of which the leaflets arise. In some plants, this office is performed by the prolonged tips of the petals, which twine round any object in their neighbourhood that can afford them support. In the Vine, the tendrils are developed from a number of supernumerary flower-stalks. The flowers of the Vine grow on short stalks, which diverge from others, and these branch from the central stem; in this manner, when the fruit is ripe, a cluster is formed, differing considerably from that in which the fruit-stalks at once proceed from the stem, as they do in the Currant. The former arrangement is called a *panicle*, the latter a *raceme*. The calyx is very small and almost undivided, looking like an expansion of the disk; within it are seen, in the bud, five petals which hold together at the point, though separate at the base; and these are afterwards detached and carried upwards by the extension of the stamens. The stamens are five in number, opposite to the

tals; there is, therefore, a whorl deficient (§ 465); and the ortive rudiments of this we find in five little glands projecting

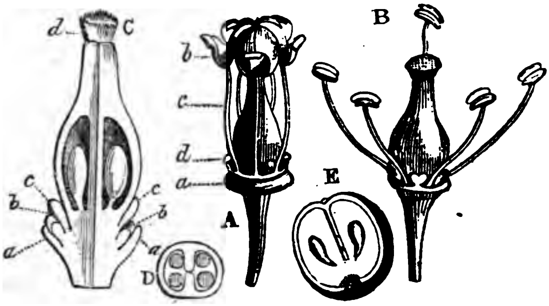


Fig. 83. Portions of the flower of Common Vine. A, flower opening; *a*, calyx; *b*, corolla, the petals detached at the bottom but united at the top; *c*, stamens; *d*, glands. B, ovarium surrounded by the stamens. C, vertical section of ovarium, showing its two cells and ascending ovules; *a*, calyx, *b*, origin of petals, *c*, glands, *d*, stigma. D, horizontal section. E, section of ripe fruit.

m the disk, which alternate with the fully-developed stamens. ithin the circle of stamens is found a two-celled ovarium, rmounted by a single stigma, which is not supported upon a le, but seated at once upon the ovarium; hence it is said to be *sile*. In each cell are two erect (§ 500) or ascending ovules. e fruit is, as is well known, a succulent berry, with from one four hard seeds contained in its pulp; the original division into o cells is nearly obliterated, when the fruit is ripe. An ditional character which may be remarked in the common Vine d its allies, and which is interesting as showing the affinity tween this order and the succeeding one, is the tendency to a elling or tumidity, in the branches, near the points from which e leaves proceed; and in the Vine, the young branches have e divisions into *nodes* marked nearly as strongly as they are in e Grasses (§ 148).

568. The plants of this group are naturally inhabitants of the lder and hotter parts of both hemispheres, especially of the East dies. There is a very close resemblance in essential characters

amongst them all; though in subordinate peculiarities the tendency to variation is considerable. The mode of growth and the form of the leaves is nearly the same throughout; and the chief obvious difference is in the size of their flowers, which are usually greenish in colour, and in the taste of their fruit. In the Fox-grape of America, for instance, the berries have a vile indescribable taste, which has been compared to the odour of the fox; in the River-grape, they are small, black, and acid, but the flowers have a delicious odour, which makes amends for their minuteness. The genera *Cissus* and *Ampelopsis*, many species of which are well known as creepers (the most common of which is the Virginian Creeper), differ from the Vines in having the leaves divided into five distinct segments; and they are remarkable for the rich crimson hue which these assume in autumn. Some species of these possess astringent properties, in addition to the ordinary acid of their fruit; and in the Virginian Creeper there is a considerable amount of acid in the leaves, which causes them, when bruised and applied to the skin, to raise blisters. Hence, these plants have been used medicinally in some countries; but not with any peculiar advantage.

569. Few plants have been more cherished, and more vituperated, than the Vine. It must be confessed that, if mankind could abstain from the abuse of its products, there is no tree that affords more acceptable or refreshing fruit; but the abuse has been so prevalent wherever the use has extended, and its consequences have been so pernicious, that it may be questioned whether the evil dispositions of man have not turned that to a curse, which the Bountiful Creator certainly intended as a blessing. The cultivation of the common vine, which is not native to Europe, but which now grows wild near the coasts of the Caspian Sea, in Armenia, &c., and which probably extended, at an early period of the history of man, over all parts of the earth then tenanted by him, may be traced to a very high antiquity. Its growth, and the preparation of wine from it, were probably branches of antediluvian history; for we read that, immediately after the deluge, Noah planted a vineyard, and drank of the wine, even to intoxi-

cation; so that the sin of habitual drunkenness is likely to have been one of those, which led to that signal manifestation of the Divine displeasure. From Egyptian tradition, the culture of the vine appears to have been practised in that country, at the earliest period of its settlement. It was gradually spread, with the progress of civilization and of intercourse between nations, from its native habitation in Central Asia, to Greece, Sicily, and Italy; and thence to Portugal, Spain, and France. Its introduction into Britain seems to have been due to the Romans; but the average temperature of this country is too low for its successful cultivation in the open air. With the assistance of artificial heat, however, aided by rich manure, and trained by horticultural skill, the vines grown in this country have surpassed all others in the size and lusciousness of their fruit. It has not been found generally worth while, however, to make wine from the juice of British grapes; since those produced in hot-houses are by far too valuable for such a purpose; and those grown without artificial heat do not contain enough sugar, to enable the fermented liquor to rival that obtained from the vineyards of warmer climates. Some centuries since, however, when foreign wines were less readily obtainable in Britain, large quantities of wine were made in the southern part of our island. Even so late as the year 1763, sixty pipes of wine resembling Burgundy were made from the produce of a vineyard belonging to the Duke of Norfolk, near Arundel Castle on the south coast of Sussex; and at the present time there are still two or three vineyards near the south coast of Devon, from which wine in small quantities is commonly made.

570. The culture of the vine as an article of husbandry extends over a zone stretching from about the 21st to the 50th degree of north latitude, and consequently about 2000 miles in breadth; and reaching in length from the western shores of Portugal to the North of India. The best wines are made about the centre of the zone; those of the north being harsh and austere; whilst the juice of the grapes of the south too soon passes into the acid fermentation, so that they are better adapted for being dried as raisins. Hence in Spain and Greece, the vine-

yards of the higher grounds produce the best wines; whilst those upon the low hot shores have always to be dried. On the other hand, in Madeira and the neighbouring islands, in which the near proximity of the sea on every side tends to prevent intense heat, some of the most highly-prized wines are produced, although they are much nearer the southern border of the zone. "A vineyard, associated as it is with all our ideas of beauty and plenty, is in general a disappointing object. The hop plantations of our own country are far more picturesque. In France, the vines are trained upon poles, seldom more than three or four feet in height. In Spain, poles for supporting the vines are not used; but cuttings are planted, which are not permitted to grow very high, but gradually form thick and stout stocks. In Switzerland, and in the German Provinces, the vineyards are as formal as those of France. But in Italy is found the true vine of poetry, 'surrounding the stone cottage with its girdle, flinging its pliant and luxuriant branches over the rustic verandah, and twining its long garland from tree to tree.' It was the luxuriance and the beauty of her vines and olives, that tempted the rude people of the North to pour down upon her fertile fields. In Greece, too, as well as Italy, the shoots of the vines are either trained upon trees, or supported, so as to display all their luxuriance, upon a series of props. This was the custom of the ancient vine-growers; and their descendants have preserved it in all its picturesque originality. The vine-dressers of Persia train their vines to run up a wall, and curl over on the top. But the most luxurious cultivation of the vine in hot countries, is where it covers the trellis-work which surrounds a well, inviting the owner and his family to gather beneath its shade. 'The fruitful bough by a well' Genesis xlix. 22. is of the highest antiquity."

571. The vine lasts to a considerable age; it spreads also to a large extent, or when supported, rises to a great height. Although it bears plentifully at three or four years, it is said that vineyards improve in quality till they are fifty years old. In France and Italy, there are entire vineyards still in existence, and in full bearing, which were in the same condition at least three centuries

ago. Many vines in this country are above 100 years old. A vine existed at Northallerton, in 1785, which covered a surface of 137 square yards, and the principal stem of which was about 15 inches in diameter; it was then about 100 years old, and it increased in size afterwards, but it is now dead. There is at present a vine grown under glass at Hampton Court, which covers a surface of 22 feet by 72, or 1694 square feet; this bears seldom less than 2000 clusters every season; and in 1816 there were at least 2240, each weighing on the average a pound. Vine-growers enumerate nearly 300 different kinds of grapes, which are all,—whether black, white, blue, or varied in colour,—but varieties of the same species. The quantity of foreign wine of various descriptions imported into Great Britain in the year 1839, was nearly *ten millions of gallons*, from which the revenue derived a duty of nearly two millions sterling. The quantity of raisins imported was about *ten thousand tons*, the duty upon which amounted to £135,000. An article still more largely imported, is known under the name of "Zante Currants"; of these, which are really small dried grapes grown in the Ionian Islands, the importation was in 1839 to the amount of more than ten thousand tons, the duty on which was nearly £190,000. These facts will serve to show the vast extent over which the vine must be cultivated, in order to yield, to Britain alone, so large an amount of valuable products.

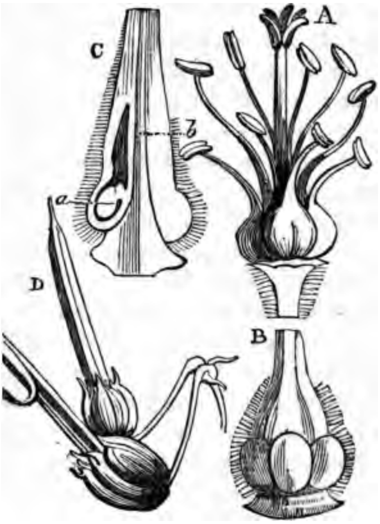
Order GERANIACEÆ, or Geranium Tribe.

572. This order is chiefly interesting on account of the large number of species which are natives of Britain, and the amount of other kinds which are now naturalized here, being cultivated for their showy and elegant blossoms. What are commonly termed Geraniums by the horticulturists are not really such, but belong to the allied genus Pelargonium. Of the real Geraniums, some species or other may be found growing wild almost every where, and are commonly known by the name of Cranesbill, which they have received on account of a peculiarity that will be presently noticed.

If we examine almost any kind of Geranium, we shall find that, as in the last order, the stems are tumid at the points from which the leaves arise;—a character which seems of slight importance, but which often runs through a particular natural group, and enables us to easily recognize the plants belonging to it. Several flower-stalks very commonly diverge from one centre (in the same manner as do the metal stretchers, by which the whalebones in an umbrella are spread asunder,) forming what is called an *umbel;* but in most of British Geraniaceæ, each principal stalk bears but two flowers. The calyx consists of five ribbed sepals, which spread asunder when the flower is open; but when the petals have fallen off, they contract again around the young and tender ovaries, to which they then form an efficient protection. The petals are also five in number, except in a few instances in which one is undeveloped; their veins are unusually prominent, and they give to the petals a streaked or pencilled appearance. These veins consist almost exclusively of air-vessels, and they serve as beautiful objects of microscopic investigation. The stamens are usually two or three times the number of the petals; in the Geraniums there are ten, and they distinctly form two rows, of which the outer one is shorter than the other; and in the Erodium or Cranesbill, also a British genus, the stamens of the outer row do not bear anthers. In the cultivated Geraniums, or *Pelargoniums*, however, there is less regularity; the stamens are more than five and fewer than ten in number; and the corolla is also somewhat irregular, the two upper petals being larger than the three lower, and standing apart, so as to give the flower the appearance of having two lips. The pistil of the Geranium tribe has a singular structure. It consists of five carpels clustered together round an axis, which is the disk prolonged upwards through their centre; in each cell of the ovarium is a single seed. The styles adhere together in such a manner as to form but a single column, divided at the top into five lobes, which are the stigmas. Fig. 85.

573. When the fruit is ripe it resembles in a striking manner the bill of certain birds; whence the British Geraniums are known by the name of Cranesbill, and the Erodium (an allied genus) by

f Storksbill. This singular appearance is owing to a very circumstance. In most plants, the styles shrink up or fall off, at the same time that the flower fades; and, by the time the fruit is ripe, they have entirely disappeared. But in the Geranium the styles continue to grow and harden as fast as the fruit itself; and when the latter is ripe, the styles project from the ovaries in the form of a beak. At the time that the fruit is ripe, the seeds are sown in a very curious manner. The carpels and styles are still clustered together round the central axis; but the latter shorten in drying; and as they adhere so closely at their points that they cannot separate there, they ac-
cause the separation of the carpels at their base; and these,
torn up as it were by the roots, curve towards the top of the
and at the same time open by the face which was previously
ent, so as to let the seed drop out. This action takes place
nly; and it may be noticed in any common Geranium whose
is mature, if gathered before the dew is off and then put in
m; the effect of its heat will be to detach first one and then
er carpel with a snapping sound,—the jerk serving to scatter



84. Structure of flower of Meadow Gera-
A, stamens and pistil. B, the lower part
pistil, showing the clustered carpels. C, sec-
the pistil, showing *a*, the ovule, and *b*, the
ged axis, round which the carpels are clus-
and which forms the hard beak in the ripe
D, a couple of ripe fruit, enveloped in the
below, the styles projecting above; *a* is a
which has been detached by the hardening
ntraction of its style.

the seeds. This peculiar mode of separation is common to the whole order, and is very characteristic of the plants included in it.

574. The Geraniaceæ are extensively diffused over the globe, some genera being restricted to one quarter, and others to a different part. The chief residence of the Pelargoniums is at the Cape of Good Hope, from which all the showy Geraniums (so called) which ornament our windows and gardens, have been derived. These have been greatly improved by cultivation, and many new varieties have sprung up; the number of these has been still further extended by hybridism, which can be very effectually performed in this group, the offspring almost always presenting a complete intermixture of the characters of its parents. Thus, if we take the pollen of a plant with blue flowers, and place it upon the stigma of one which has red flowers, the seed will produce a plant having purple flowers; or if we cause a sort with large unsightly flowers to intermix with one having small neat flowers, we shall probably obtain a variety having large flowers that are as neat in appearance as those of the small flowered kind. This intermixture will only take place, however, among varieties of the same species, or among species nearly related to each other; there are some Pelargoniums which will not hybridize together; and the Pelargonium is not fertile with the Geranium. The Geraniaceæ are not marked by any very active properties; they possess, however, some astringency, and also an aromatic resinous principle. The stem of a foreign species of Geranium burns like a torch, and gives out an agreeable odour. The root of an American species is considered a valuable astringent, and is known by the name of Alum root. The British species commonly termed Herb-Robert, is held in repute for its medicinal virtues in some parts of the country.

575. Very nearly allied to the Geraniaceæ is the small order *Tropæoleæ*, of which the members are all natives of tropical America, but of which one species is now commonly naturalized in our gardens under the name of *Nasturtium*, (which is, however, an incorrect one) sometimes abbreviated into Sturtion, or occasionally Trophy-cress. The common name refers to the similitude it bears in taste, smell, and general properties, to the true Nasturtia

or Cresses;—a similitude so great, that the same insects resort to and feed on both. The plant is cultivated in Britain for the sake of its unripe ovaria, which possess an agreeable pungency of flavour, and are pickled to be used like Capers as a sauce to boiled mutton. This order differs from the last, chiefly in the following particulars. The sepals of the calyx are unequal in size, and one of them is provided with a long distinct spur (of which a rudiment, however, may be traced in Pelargonium); this is subject to great varieties of form; indeed a series of monstrosities, such as may often be easily collected from a single bed of these plants, presents many curious phenomena. There seems a great tendency towards the return to a regular form, by the equalisation of the sepals; in some instances the spur will be found nearly or altogether deficient; whilst in others it will be double or triple, the three being sometimes united, sometimes divergent from each other. In one curious specimen which came under the Author's notice, a second spur grew from the first,—not downwards, however, but upwards into the flower, just as if we push back the finger of a glove, so as to project into the part that receives the hand. The petals are also more or less irregular, three being smaller than the rest, and these being occasionally undeveloped. The stamens are eight in number, and are perigynous or adherent to the calyx (§ 498). This, then, is an instance in which an exception occurs to the character that has been taken as the chief guide in classification; for although the perigynous stamens, considered in themselves, would cause the order to be removed into the next class, yet its affinity with other Thalamifloræ, and especially with Geraniaceæ, is so manifest, that it cannot be properly removed from that group. The ovary is made up of three carpels, adherent as in the last order, around a central elongated axis; these each contain a single seed.

576. Another allied order is that of **Balsamineæ**, the *Balsam* tribe; this has not, however, any of those medicinal virtues which might be inferred from its name, but consists only of a small number of plants, which are esteemed for the beauty of their flowers and their elegance of aspect. Of these, one species is a

native of Britain, though it is rarely found wild; and this is remarkable for the curious manner in which its seed-vessel opens (§ 419). There is greater irregularity in the flower than in either of the two last orders; so that the nature of its parts might not be understood at first sight. The sepals are five in number, but unequal and irregular in form; the two upper and inner ones are adherent, while the lower one is spurred. There are only four petals; and these are adherent in pairs; so that the corolla appears as if it consisted of two only. The stamens are five in number, and their position is regular; so that, by comparing their places with that of the petals, it becomes evident that each of the apparently-single petals consists of two, and that a fifth petal, which should occupy the space between them, is undeveloped. The ovarium is made of five carpels clustered together, their cavities remaining separate; the stigma is *sessile* on its top, as in the Poppy (§ 523), and exhibits a greater or less division into five parts. The Balsams usually grow in damp places among bushes; and one or two species are found in nearly every quarter of the globe.

577. Another small order, allied to the Geranium tribe, is that of OXALIDEÆ, or *Wood Sorrel* tribe; which is chiefly deserving of notice, on account of an important product yielded by some of its species. The Wood Sorrel *(Oxalis)* and its allies are herbaceous plants, which abound most in the warmer temperate regions, especially in America and at the Cape of Good Hope; but two species are found in the woods and shady places of this country. In the structure of their flowers they differ but little from Geraniaceæ; their calyx and corolla each consisting of five equal leaflets; their stamens being ten in number, arranged in two rows, of which the outer one is the longest; and their ovaria consisting of five adherent carpels. The stamens are generally united at the base, however, into a single bundle; there is no central axis in the midst of the car-

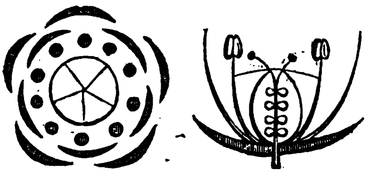


Fig. 85. Diagram of the flower of Oxalidcæ.

pels; the styles are distinct; and there is a minute but important difference in the structure of the seed. They are further distinguished by the division of their leaves, which are generally compound; and, if simple, become so merely through the want of development of some of the segments. In this group, as in the Balsamineæ and Geraniaceæ, there is a provision for the scattering of the seeds by the sudden rupture of their integument, which possesses elasticity enough to expel them with some force. The Wood-Sorrel is one of the plants whose leaves droop very evidently at night. The property which is most characteristic of the Oxalideæ is the acid nature of their juices, which is chiefly to be noticed in the common Wood Sorrel of this country. The acid is peculiar in its properties, and is named *oxalic* from its existing in this plant, from which, indeed, it was at first obtained. Its uses in the arts have already been noticed (§ 401). The quantity obtainable from this and other plants which furnish it, is too small for the supply of these; since, from twenty pounds of the leaves of the Wood Sorrel, which yield about six pounds of juice, not quite three ounces of oxalate of potash can be obtained. Since, therefore, it has been ascertained that the acid might be obtained pure by the action of nitric acid upon sugar, this mode of producing it has been generally adopted, except in places where the plant is very abundant. One Indian subdivision of this tribe differs from the rest, in the larger size of the species belonging to it, which grow into bushes or even trees; and some of these are cultivated for the sake of the juices afforded by the leaves, flowers, and fruit, which are of a pleasant acid character, and are esteemed as cooling remedies in fevers. One species, moreover, is remarkable for the great irritability of its leaves, which perform movements resembling those of the Sensitive Plant; and there is a foreign species of Oxalis, that has in some degree the same property

578. The last order of Thalamifloral Exogens to be here noticed is that of RUTACEÆ, the *Rue* tribe, of which several species are cultivated in our gardens, though none are originally natives of this country. All the plants of the order are remarkable for their powerful odour, which is usually of a nauseous

character; and this is due to the quantity of essential oil, secreted in little cavities beneath the cuticle of the leaves, the place of which, as in the Orange tribe, is marked by half transparent dots. To this group belongs the Fraxinella, formerly mentioned (§ 374) as rendering the surrounding air inflammable in warm weather, by the quantity of this oil which it diffuses through it. The common Garden Rue will give a very good idea of the structure characteristic of the order. The parts of its flower, however, are arranged in fours; whilst those of other species are disposed in fives. The calyx consists of four sepals diverging widely from each other; and within these, alternating with them, are four petals. The stamens are eight in number; and they arise from a fleshy ring surrounding the ovary. Upon this ring is seated the ovary, which consists of four carpels united into one mass. They do not stand upright, however, as they usually do; but spread away from each other at the base, being arranged on the sides of a conical disk, which rises up between them, but is not continued into the style. This disk is termed the *gynobase*, or base of the

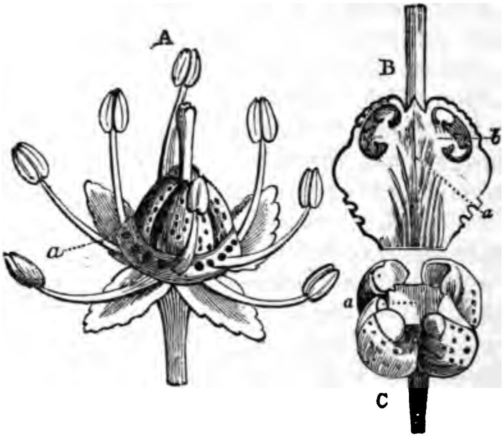


Fig. 86. Garden Rue. A, magnified flower deprived of petals; *a*, fleshy ring from which the stamens arise. B, section of ovarium; *a*, the gynobase; *b*, the placentæ. C, a seed-vessel after bursting; *a*, the gynobase.

female organs (§ 484.) The style is single, being formed by the adhesion of those of the several carpels; but it separates at the top into four stigmas. The seed-vesel, when ripe, splits into four valves, leaving the thick hard gynobase in the centre. The number of seeds contained in each varies considerably, but is almost always less than that of the ovules. In the common Rue, there are about four ovules in each cell; but only one of these is developed into seed. In others the ovules and seeds are more numerous. One genus (Correa) of this order presents an interesting anomaly, of a similar character to that which has been mentioned as occurring in the order *Tropæoleæ;* the petals cohere together into a tube, so that the plant is really Monopetalous; but it is not placed in that division of the group, since in its general structure it is so closely allied to the Rutaceæ, that it cannot be separated from them.

579. The principal habitation of the Rue tribe is the South of Europe, whence it extends through the temperate portion of the Old World, rarely advancing within the tropics. The common Rue was formerly much esteemed in medicine; it was mentioned with approbation even by Hippocrates, and for many centuries it was considered a preventive of contagion, and was known under the name of 'herb of grace.' It is now, however, seldom employed, except by village doctresses.

580. The following table will be found to express, in a concise form, the most evident points of difference among such of the foregoing orders as contain Plants found in Britain; so that the Student will have little difficulty in assigning to its correct place a specimen of any one of them, which he may meet with. It is to be remembered, however, that there are orders of minor importance, which are not altogether excluded by these characters, and that the specimen *may* belong to some of them. But as all those which include the commonest wild and garden flowers have been adverted to, this is not likely to happen.

Class EXOGENS.

Sub-class THALAMIFLORÆ.

Flowers possessing calyx and corolla, the latter composed of distinct petals. Stamens, as well as petals and carpels, arise at once from the disk; except when sometimes slightly adherent to the sides of the ovary.

A. *Stamens more than* 20.

a, Ovary superior.		
α, Leaves without stipules.		
Carpels distinct	*Ranunculaceæ*,	504.
Carpels united	*Papaveraceæ*,	523.
β, Leaves with stipules.		
Calyx imbricated	*Cistaceæ*	536.
Calyx valvate.		
Stamens monadelphous,	*Malvaceæ*	546.
Stamens distinct	*Tiliaceæ*	557.
b, Ovary partly inferior	*Nymphaceæ*,	520.

By the use of such a table as this, almost any British plant may be referred, with great facility, to its proper Order in the Natural System. For example, we pick in our walk through a lane a specimen of the common Chickweed, or Stitchwort. The veined structure of its leaves, the prevalence of the number five in its flowers, and its general aspect, prevent any doubt that it is an Exogen. On examining the structure of the flowers, we at once perceive that the stamens are hypogynous; for we may pull off both calyx and corolla, without detaching them from the disk, on which they are separately inserted. The plant belongs, therefore, to the sub-class Thalamifloræ. The stamens may be from five to ten in number; it is comprehended, therefore, in the second

B. *Stamens less than* 20.

, Leaves with stipules; carpels consolidated.		
a, Placentæ parietal.		
Leaves unfolded from spiral coil,	*Droseraceæ*,	540.
Leaves unfolded straight ..	*Violaceæ*,	538
β, Placentæ in axis.		
Fruit with beak	*Geranioceæ*,	572.
Fruit without beak.		
Stamens monadelphous,	*Oxalideæ*,	577.
Stamens opposite petals,	*Ampelideæ*,	566
, Leaves without stipules.		
a, Carpels distinct, anthers with valves,	*Berberideæ*,	519.
β, Carpels consolidated.		
Placentæ in axis, stamens tetradynamous	*Cruciferæ*,	529.
Placentæ parietal, stamens not tetradynamous.		
Styles distinct.		
Calyx tubular	*Caryophylleæ*,	541.
Calyx imbricated ..	*Linaceæ*,	543.
Styles united, leaves dotted,	*Rutaceæ*,	578.

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ion (B) of the table. Its leaves are readily seen to be without les, and we consequently look for it in the group of orders below n examining the carpels, they are seen to be consolidated ; and, on ıg across the ovarium, the placentæ are found to be parietal; it , therefore, belong to one of the three lowest orders in the table. ınot be a Rue, since its leaves are destitute of glandular dots; it , therefore, be either one of the Linaceæ or Caryophylleæ, the most ıus difference between which is in the structure of their calyx, as ɘrly explained (§ 543.) When the plant has thus been referred to ·oper order, the whole of the general account given of that order ›e found applicable to it, and to other species closely allied to it.

SUB-CLASS II. CALICIFLORÆ.

581. It will be remembered that, in this division of the Exogenous Phanerogamia, the sepals of the calyx are always adherent to each other. and that the petals and stamens appear to arise from them, rather than from the disk or receptacle, to which they may really be traced Taken as a whole, this division cannot be regarded as containing a number of species, of essential service to man, equal to that which has been shown to be comprehended within the former one; yet several orders of very great interest and importance are comprehended in it. To these it will be desirable to give our principal attention, passing over a large number of other groups with little or no notice.

582 The first order which presents itself is that of CELASTRINEÆ, in which the common *Holly* is placed by many Botanists. This order is characterized by the possession of 4 or 5 sepals, united at the base, and of an equal number of petals alternating with them. The stamens, again, are the same in number, and alternate with the petals; and they are perigynous (§ 498) in their insertion. The ovarium is superior, and is composed of several adherent carpels; it is partly enveloped in a large fleshy disk, and usually contains from two to four cells, each of which may include one or several ovules. The style is single, but separates at the top into two or four stigmata. The species of this order are mostly trees or shrubs, the flowers of which are not conspicuous. The section to which the Holly belongs is distinguished by having the petals in some degree adherent to each other; and hence it has been placed by some Botanists, as a separate order, among the Monopetalæ. The common *Holly* is one of the few British species of this order, which is pretty generally distributed over the surface of the globe. It is a very slow-growing tree, rarely attaining any great size; its wood is much used by turners (being one of the hardest of the white woods), especially for the manufacture of the toys known as Tunbridge ware. The inner bark abounds in a tenacious substance. which, when separated, is known as bird-lime, from the use to which it is put in entrapping birds. The bark and

leaves are bitter, and have been used as a substitute for other analogous substances, in the cure of intermittent fevers. From the leaves of a species of Holly which is a native of South America, the inhabitants of that country make an infusion, which is employed as *tea* is among us; this is known as Maté or Jesuits' Tea, and is very extensively cultivated and consumed in Brazil, Paraguay, Chili, and Peru. Another species which inhabits the Southern part of North America, furnishes the Indians with a similar article, which is used by them as a medicine, and also as a draught of etiquette at their solemn councils. Another British species is the *Euonymus*, known under the name of *spindle-tree*, or *prick-wood*, from the uses to which it is applied. It has a wood which, without being hard, is very tough; and this was formerly much employed in making spindles for the spinning-wheel. Now that the *jenny* has superseded the distaff, however, this is little used except for making toothpicks and skewers; and also by watchmakers, for cleaning delicate machinery, for which it is very well adapted on account of the fine point with which it may be worked without breaking. The second of its common names seems to render it not improbable, that it was formerly used in the manufacture of those skewer-like pins, which were employed to hold dress together as late as the reign of Henry VIII, when the manufacture of metal pins became more general. The fruit and the bark of this tree have properties, which render them poisonous to most animals, and which give them purgative and emetic effects if taken by man.

533. Nearly allied to the last order is that of RHAMNEÆ, or the *Buckthorn* tribe; which may, however, be readily distinguished from it by the position of the stamens, these being here found opposite to the petals, or alternating with the sepals The structure of the calyx is also different,—that of the Rhamneæ being *valvate* (i. e. the sepals having their edges in proximity with each other), whilst that of Celastrineæ is somewhat imbricated (the sepals overlying one another). The ovarium is partly enveloped, as in the last order, by the fleshy disk; and this, as the fruit ripens, grows over the ovary, and completely encloses it. The species

of this order are distributed over nearly the whole world, with the exception of the arctic regions. They are mostly shrubs or low trees which are generally remarkable for their spiny character; this manifests itself strongly in the common Buckthorn of this country, and in the Christ's Thorn, which abounds in Greece and Palestine, and which has been naturalized in our gardens. The latter derives its name from the tradition that our Saviour's crown of thorns was made from it. The spines are, as formerly explained (§ 307), undeveloped branches; and a little examination of any spiny bush will make this evident, since all stages of development may be found, between the simple thorn and the complete branch. As already stated, cultivation has a tendency to do away with this character, by supplying the plant with nutriment sufficient to develope the buds that would otherwise be abortive. Upon the final cause, or object, of this curious provision, the following excellent remarks, by an eminent Botanist, may be quoted. "In open barren tracts of country, the very circumstance of the sterility of the soil must prevent the production of many plants; and of those which grow, few will be enabled to perfect many seeds. It is necessary, therefore, to protect such as are produced, from extermination by the browsing of cattle; otherwise not only would the progeny be cancelled, but also the present generation would be cut off. And what more beautiful and simple expedient could have been devised, than ordaining that the very barrenness of the soil, which precludes the abundant generation by seed, should at the very same time, and by the very same means, render the abortive buds a defensive armour to protect the individual plant, and to guard the scantier crop, which the half-starved stem can bear"?

584. The inner bark and fruit of most species of this order are possessed of active purgative powers; and some of them are also emetic and astringent. The syrup made from the juice of the berries of the common Buckthorn was formerly much used in medicine; but, as its operation is attended with much discomfort, it is now seldom employed except for administration to dogs. The berries afford, however, a valuable colouring matter, which is used in dyeing. The "French berries" of the shops, from which a

beautiful yellow is obtained, are the unripe fruit of this plant; and from their juice, when they are ripe, the colour termed sap-green is prepared. Another species affords the colour with which yellow morocco leather is tinged. The fruit of a species allied to the Christ's Thorn, however, contains a large quantity of gummy matter, without any substance possessing active properties; this, which is known under the name of the *jujube*, is a favourite dessert in Italy and Spain, either when fresh, or when dried as a sweetmeat; and lozenges made from it are much employed in this country as a remedy for coughs. The *Lotus*, the fruit of which has been celebrated from the time of Homer, also belongs to this order. It is a native of Persia, and grows wild on the north coast of Africa as well as in its interior; and its fruit is eaten by the inhabitants, wherever it grows. It is converted into a sort of bread, by drying and pounding; and from its juice, when pressed out and mixed with water, and afterwards fermented, a sort of wine is commonly made. The leaves of one Chinese species, are used for tea by the poorer classes in that country; and another produces a sort of fruit, which is said to resemble a pear in flavour, but which is nothing else than the flower-stalk become fleshy.

585. Passing over several small orders of little importance, we come to that of TEREBINTACEÆ, which contains a large number of species inhabiting tropical countries, distinguished by their resinous secretions, and, at the same time, by their poisonous properties. The number and arrangement of the parts of the flower differ considerably in the different sections of the order; so that many Botanists subdivide it into three or more. The flowers are sometimes complete, but not unfrequently one or other set of organs is suppressed in some of them, so as to render the plant *polygamous* (§ 483); and some species are diœcious. The sepals are from 3 to 5 in number, more or less united together, and imbricated. The petals, when present, are equal in number to the sepals; but they are occasionally absent; they alternate with the sepals, and are sometimes adherent to each other. The stamens are either equal in number to the petals, or are twice as numerous, and are

inserted at the bottom of the calyx, or around the ovary. The carpels are sometimes distinct, and sometimes adherent; but the styles are always distinct. The ovules are few in number in each carpel, and are usually solitary. Most of the species are trees or shrubs, having alternate leaves, which are usually compound. The resinous matter is chiefly contained in the bark, whence it frequently exudes naturally, or may be drawn by incisions. Gum Mastic (§ 377) and Chian Turpentine (§ 375) are obtained from species of this order; as are also Sumach and the Japan and Chinese black varnish, and probably Olibanum. The fruit is very commonly acrid and astringent, and these qualities usually exist in some degree in the bark also. The well-known Cashew-nut of the East and West Indies is produced by a plant of this order. Its appearance, whilst still connected with the plant, is very curious. The nut is borne at the extremity of a fleshy fruit considerably larger than itself; which is nothing else than the peduncle or flower-stalk enlarged and become succulent. This fruit, which is termed the apple, has an agreeable acid flavour, slightly astringent, and is much esteemed in the West Indies, where the juice expressed from it is fermented and made into a kind of spirit. Between the two layers of the pericarp or ripened carpel, there is found a considerable quantity of inflammable oil, which is so acrid as to blister the skin if the fingers or teeth be used in removing the shell. The kernel abounds with a milky juice, and is much esteemed for its flavour. The juice of the nut of an allied species is of a deep black when ripe, and leaves an indelible stain if applied to linen, &c.; so that it makes an admirable natural marking-ink. The Mango, a fruit highly prized in India, which has been naturalized in the West Indies also, is produced by another species of this order; several varieties of the fruit are cultivated, differing much in size and flavour. They vary in weight from a few ounces to several pounds; some have a most delicious, aromatic, sweet, and slightly acid taste; whilst in others, the resins so much abound that the flesh is ill-flavoured, and, being at the same time fibrous, has been not unaptly compared to a mixture of "tow and turpentine." The tree is a very handsome one; as is also that from which the black varnish of India is obtained. This varnish, whilst still liquid, is so acrid in its properties as to blister the skin, if allowed to touch it. A fruit much esteemed in the south of Europe, as well as among Eastern nations, is the Pistachio nut, which is the produce of one of the diœcious species ; and in Sicily, a ceremony similiar to the marriage of the Palms (hereafter to be described) is performed, in order to ensure the fertilization of the seeds.

Order LEGUMINOSÆ, or Pea Tribe.

508. This is one of the largest and most important of the whole group. There are few which are more easily recognized, or in which greater interest is usually taken. It is extremely rich in plants useful in various ways to man. Some furnish him with a large quantity of wholesome and palatable food for himself, such as the Pea, Bean, Lentil, &c; whilst others afford equally nutritious food for cattle, such as Clover and Lucerne. Others yield valuable dyes, such as Indigo and Logwood; and others again have stems which serve as excellent timber, such as Brazil-wood, Rosewood, and the American Locust-trees. From others are derived valuable medicinal products, such as Senna and Cassia, or Gums, as that of the Acacia. Others, again, are attractive on account of their beauty, such as the Laburnums, Robinias, &c. ; and others are interesting on account of physiological peculiarities, such as the Sensitive-Plant (§ 421), the Gleditsias (§ 238), and the New Holland Acacias, (§ 228).

Among all these there is a strong *family likeness ;* but there is every variety of *size* among the very numerous species which this order contains ; some being humble plants, whilst others are lofty trees. The most important point in which they all agree, is in the structure of their fruit, which is a *pod* or *Legume ;* whence the name of the order is derived. A legume may be thus distinguished from all other kinds of fruit. It is a carpel which grows long and flat, and separates when ripe into two valves or halves; it usually contains several seeds, which are attached to one angle only of the inside of the carpel. A Pea-pod is as apt an illustration as any that can be furnished; and, by referring to Fig. 59, the mode in which the pod is formed from the carpellary leaf will be at once evident. The ovules proceeding from the thickened edges of this leaf, which are folded together, are attached alternately to the one valve and the other; so that, when the pod is opened along the *suture*, or line of adhesion, (as is commonly done in shelling peas) half the seeds remain attached to each valve and lie in its hollow. The seed-vessels of all the plants of this order, however, must not be supposed exactly to resemble the Pea-pod; they may be longer or shorter, larger or smaller, harder, thinner, or differently coloured, or may contain more or fewer seeds; but they are always formed essentially upon the same plan.

587. A very large proportion of the order are further distinguished by a singular arrangement of the petals, from which they have been termed *Papilionaceous* plants, owing to the resemblance which their flowers bear to a Butterfly at rest. Of this structure, the common Pea is an excellent illustration. If we examine its flower, we shall find a calyx composed of five small nearly equal sepals united into a short tube. The corolla is much larger, and consists of five petals, one of which greatly surpasses the rest in size, standing at the back of them, and over-wrapping them before the flower expands; this is called the standard or *vexillum*. In front of this are two smaller petals, which stand nearly parallel with each other, converging a little at the point; these are the wings, or *alæ*. They are carefully folded over a boat-shaped curved part of the corolla, which is placed in front of all the rest; this part, which is termed the keel or carina, is formed of two petals, that are slightly adherent at their lower edge, but they are separately inserted at their base.

588. There is considerable variety, in this order, as to the number and degree of adhesion of the stamens. The *Papilionaceous* division of it may be separated into those which have their stamens united, and those in which they are distinct. The former

group contains all the European species, such as Peas, Beans, Vetches, Clover, Trefoil, &c. The stamens are usually double the number of the sepals (of which there are occasionally only four); and very commonly one of them is distinct, whilst the rest are united into a tube, as is the case in the common Pea, Vetch, &c. The division of the Papilionaceous Leguminosæ having the stamens separate, contains few but New Holland species. The ovary is a tapering green hairy body, gradually narrowing into a a style, which ends in a minute stigma. It is one-celled, and is to be regarded as consisting of but a single carpel, the others not having been developed; sometimes, however, two or even five carpels are to be found in the centre of the flower.

589. In another division of the Leguminosæ, containing the Senna, Logwood, Tamarind, and many other interesting species the flowers present a much nearer approach to regularity. Their petals spread equally round the pistil, as in other plants; and their stamens also are spreading and separate. A degree of that irregularity in size, however, which is so striking among the *Papilionaceæ*, is here still evident; some of the petals or stamens being larger than the remainder. Few of this group are ever seen in this country; but in foreign climes they are very abundant.

590. The third division of this order comprehends those which have flowers formed upon the plan of the last,—that is, not being papilionaceous,—whilst the number of stamens is much greater, being triple or quadruple that of the sepals. The flowers are extremely minute, and grow in compact clusters; the stamens have very long, slender, and separate filaments. This is the structure of the division which includes the *Mimosas*, amongst which is the Sensitive Plant. Many of these have a very elegant appearance, the clusters of flowers which they bear being numerous, and often presenting gay colours.

591. Besides the peculiar structure of the fruit, in which these subdivisions all agree, the entire absence of a separate albumen,—so that the cotyledons are fleshy, and occupy with the embryo the whole interior of the seed,—is a character of great importance, which prevails through the whole group, and shows it to be a

natural one. The number of species already known is very considerable, certainly not less than 4000; and many more must remain to be discovered. The order is diffused over the whole habitable globe. Some species of it have a very extensive range; whilst others are restricted to particular countries. The Papilionaceous division with united stamens contains most of the former; but these appear to flourish best in temperate and moderately warm latitudes, diminishing in number towards the poles, and giving place to the Mimosa and Cassia tribes nearer the equator.

592. The properties of the different species of this order are so various, that it is difficult to enumerate them all. Their difference may also appear to invalidate the principles formerly laid down, respecting the correspondence between structure and properties (§ 479); for, whilst some of them seem to be remarkable for nothing but the large quantity of tasteless gum which they contain, others are violently irritant, and others strongly astringent. The seeds of the common Laburnum, for example, of which the flower and the pod very much resemble those of the Pea, are violently emetic and purgative, and have proved absolutely poisonous to children. The seeds of other species are very bitter, and are valued in India for their tonic virtues. The character of the juices which may be extracted from the wood, is equally various. This apparent exception, however, does not really weaken the principle; since the number of points of difference among the several tribes is so great, that there can be little doubt that they might be subdivided into several orders, each of which might be characterised by properties peculiar, or nearly so, to itself. Having already adverted to some of the best known among the useful products of this order, we may here mention a few others. The pulp of the Tamarind, which is so grateful in thirst on account of the large quantity of acid it contains, lies between the seeds and the valves of a legume; as does also that of the Cassia, which has a sweetish taste, and which is useful as a mild aperient for children. Liquorice is derived from the juice of the roots of the plant which yields it. The juices of other species are powerfully astringent, and are

used both in medicine and in arts; of this kind are Catechu, (§ 365), Kino, and other substances. The bark of the New Holland Acacias has been introduced into this country as a material for tanning. The fragrant resins, called Balsams of Tolu and Peru, which are in much use for burning as perfumes, and for medicinal purposes, are the produce of a South American species. Full details regarding Indigo, one of the most valuable products of this order, have been given on a former occasion. Some species, which are found in the West Indies and in South America, contain juices which have a remarkable power of intoxicating fish, rendering them easy of capture, without injuring their wholesomeness as food.

593. The next order is one of nearly equal extent and importance, containing, like the Leguminosæ, a large number of species having the same general resemblance, yet differing in the structure of many important parts. This is the order ROSACEÆ, or Rose tribe, to which belong not only Roses and their immediate allies, but a large part of our most valued fruits, which seem very unlike each other, such as the Strawberry and Apple, the Raspberry and Pear, the Medlar and the Almond, &c. They all agree, however, in the general plan of the structure of the flower, which may be studied in almost any of the ordinary wild species. The Strawberry flower will, perhaps, at first serve the purpose better than the Dog Rose, or any of the true Roses; on account of a peculiarity in the latter presently to be mentioned. On looking at the outside of the Strawberry flower, we observe what is apparently a calyx consisisting of ten sepals; this would be an exception to the general rule of the group, which is to have only five parts in the calyx; and, on looking further, it is seen that these leafy parts are arranged in two rows, of which the lower or outer one may be considered as formed by bracts. The corolla consists of five equal petals; and within these is a large number of stamens. Up to this point, then, we find nothing to distinguish Rosaceæ from Ranunculaceæ; but, upon looking at the position of the stamens, we observe that, instead of rising directly from the receptacle beneath the carpels, they seem to grow out of the side

of the calyx. The pistil of the Strawberry is very much like that of a Crowfoot; for it consists of a large cluster of non-adherent carpels, each having its own style and stigma, and containing a single seed. The transformation of such a flower to the fruit of the Strawberry seems very strange until the process is understood. When the corolla has fallen off, and the calyx has closed on the tender fruit, the receptacle on which the carpels are set, gradually swells, and separates them from each other, bearing them on its outside. It becomes, at last, the soft juicy fruit; and what appear to be the seeds on its outside, are in reality the carpels, which were originally in proximity with each other, and are now dry and in close contact with the real seed-coats. The calyx remains at the base of the swollen receptacle.

594. It is principally in the number of carpels which undergo development, and in the degree in which these are united together, that we meet with variety in the structure of the flowers and fruit of this order. In the Raspberry, we find the structure of the Strawberry but slightly modified. The calyx has evidently here but five parts; the petals are five in number; the stamens are indefinite in number and adherent to the calyx; and the carpels are numerous and distinct, and are supported upon a fleshy receptacle. In the ripening of the fruit, however, this receptacle does not enlarge, as in the Strawberry, but remains as the white hard *core* of the fruit; and the fruit itself consists of the carpels, which instead of becoming dry, acquire an increase of juice; and it is the soft fleshy walls of these carpels that form the succulent part in which the seeds are imbedded, and from which the core may be withdrawn.

595. If we now turn our attention to the Rose tribe, we shall find that the flower is constructed upon a plan which appears similar, until we examine the centre of it, and there we find a tuft of stigmas without any visible carpels. On looking further, however, and pressing the flower forcibly, we find that the styles rise up from the neck, as it were, of an oblong green body, which, being below the calyx, looks like an inferior ovarium. On splitting this body perpendicularly it will be perceived that it

is in reality the tube of the calyx, formed by the adhesion of the sepals, which closely envelopes the ovarium, and is contracted into a narrow orifice at the point whence the styles arise. The ripe fruit of the Rose, known by the names of Hip, Hep, or Haw, is nothing else than this tube of the calyx,—which may be regarded, perhaps, as a hollow prolongation of the receptacle,—turned red and fleshy; and in its interior will be found the carpels, changed to bony grains. The Apple and Quince, and their allies, are constructed very nearly upon the same plan. The principal difference consists in this, that the ovaries and the tube of the calyx completely coalesce, and form one body, which becomes the fruit. The eye at its end marks the point from which the calyx spreads out; this is better seen in the Medlar. The principal part of the flesh of the Apple consists of the tube of the calyx or the prolonged receptacle; but in its interior are found the five carpels, whose thin walls are somewhat horny. In the Medlar these are thick and have a bony firmness.

596. In the *Almond* tribe, which includes the Plum, Apricot, Peach, Nectarine, Cherry, and all similar fruits, there is only one carpel developed; and this in time changes to the fruit, which is termed a *drupe*, consisting of a hard shell enveloping the kernel, and itself inclosed in a soft flesh. These all agree in the peculiar properties which they derive from the presence of a certain quantity of Prussic Acid (which, when of full strength, is one of the most violent poisons known) in some part of them,—usually either the seeds, or leaves, or both. The quantity is so small as to cause no danger in making use of such parts, unless this ingredient be concentrated in any artificial mode, as it is in what is called Laurel Water, which is distilled from the leaves of the Prunus Laurocerasus, or Cherry Laurel, and is used for giving a flavour to various sweet dishes and liquors.

597. This order principally abounds in the cold and temperate regions of the northern hemisphere. In fact, scarcely any species of the Rose, Apple, and Almond tribes are found elsewhere. There is a small group, however, distinguished from the rest of the order by the constant absence of petals, which abounds at the

Cape of Good Hope, where it represents the Rosaceæ of Europe. Of this group (which is ranked by some as a distinct order) the British genus *Sanguisorba* or Burnet, is an example; the latin name of which is derived from its supposed power of stanching the flow of blood. Another British genus belonging to it is the *Alchemilla*, or Lady's Mantle, one species of which is common in fields and gravelly soils. This group is characterized by a greater degree of astringency than that which usually exists in the true Rosaceæ; although many of the latter also possess this character. The roots of the *Potentilla*, or Cinque-foil, and of the Tormentil, have been used in tanning; and the roots of a kind of Bramble afford a popular astringent medicine in North America. The leaves of the Sloe and other species have been used as substitutes for tea; and the fruit of the common Dog-rose and other allied species has a degree of astringency which renders it useful in medicine.

598. The next order which will be here noticed is that of RHIZOPHOREÆ, the Mangrove tribe, which is chiefly remarkable on account of the singular mode of growth observed in the trees belonging to it. The Mangroves are tropical trees, growing on the banks of large rivers, or on the sea-coast, and even within the bounds of the ocean as far as low-water mark. Their mode of rooting consists, not like that of ordinary trees, of divisions of the stem beneath the ground, but (as it were) of arches of roots above it, so that a more extended base is formed, and a firmer hold established, in the loose and swampy soil. From the summit of these overbending roots, the trunk of the Mangrove springs, as shown in

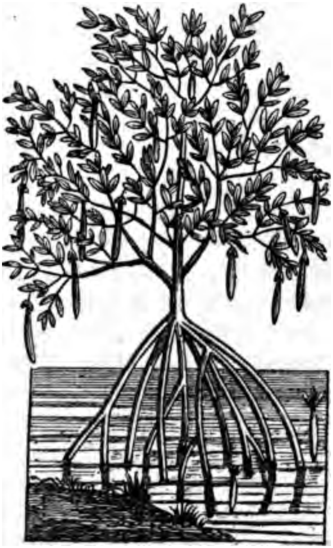

Fig. 87. Mangrove Tree.

the adjoining figure. The calyx in this order is formed of from 4 to 13 adherent sepals; and the petals are equal in number to the sepals, and are inserted upon them. The number of the stamens is double or triple that of the petals; and instead of alternating with these, they are opposite to them, as well as to the sepals. The ovarium is two-celled, being formed by the union of two carpels, which have separate cells; and each cell contains several ovules. But in the ripe fruit, we find but one cell and one seed, this having been developed at the expense of the others. These seeds are peculiar on account of their power of germinating whilst yet within the seed-vessel. The final cause or purpose of this singular provision is evident, when the circumstances under which the tree grows are considered. Were they to be shed as seeds usually are, they would fall into the water, and be carried by the waves of the sea, or by the currents of the rivers, on the margins of which they live, far from any place that is fitted for their growth. But by the long radicle perforating the seed-vessel, the seedling plant, when dropped, becomes fixed in the swamp; and thus forests of Mangroves are formed of vast extent, unsafe to be trodden by human foot, but over which the savage natives pass, leaping or climbing from root to root for many miles, without once daring to trust their weight upon the treacherous marshy ground. These swamps continually encroach on rivers, lakes, and seas; for the network of roots intercepts and collects all the solid matter brought down by the rivers; and, as a large part of this consists of decomposing vegetable matter, the mangrove-swamps are peculiarly unhealthy to human beings, who are very liable to suffer

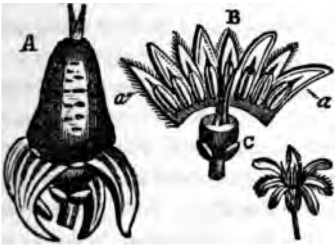

Fig. 88. Parts of the flower of Mangrove. A, the fruit, seated upon a calyx of four sepals, and surmounted by two styles. B, a flower cut open, showing four petals alternating with four sepals, (the latter being hairy), and eight stamens situated opposite to these; the pistil is left in the centre.

from pestilential fevers, if too long exposed to their emanations. When the roots of the Mangroves in such places are left bare by the ebb of the tide, they are seen to be covered with oysters and other shell-fish, which cluster around them; and hence originated the wonderful tales of the early voyagers in tropical climates, who affirmed that, in the East and West Indies, oysters, &c. grow upon trees. The properties of this order are astringent; and the bark of several species is used, in the countries where they grow, for dyeing black with iron.

599. The succeeding order, ONAGRARIACEÆ, requires notice chiefly on account of its containing several British species, among which may be mentioned the *Œnothera* or Evening-Primrose, and the *Epilobium*, or Willow-herb. The former derives its common name from the circumstance of its beautiful yellow flower unfolding to the evening sun, but retiring with the glare of advancing day. Its scientific name, which means Wine-trap, was conferred upon it on account of the use formerly made of its roots, which were eaten after dinner (as olives now are) as an incentive to drinking; it was originally called *Onagra*, or Ass-food; and from this name, that of the order has been derived. Of the latter, a great many species exist in this country, some of which may be found in almost every hedge. They may be at once recognised by the peculiar position of the flower, which seems placed at the top of a long pod or seed-vessel, whence the scientific name (meaning *upon a pod*) is conferred upon it. One of the species of this, known as the *Great Hairy* Willow-herb, is among the finest of all our British herbs; its stout hairy stems rising to the height of five or six feet, and being terminated by long clusters of bright red flowers. The typical genera of this order may be at once distinguished by the prevalence of the number *four* in *all* the parts of the flower. The calyx consists of four sepals, which adhere at their lower part, so as to form a long tube enveloping the ovarium; and they not unfrequently adhere in some degree, after they have diverged from the top of this, so that the calyx appears as if it were divided into only two portions. From the top of the tube of the calyx arise four petals; and within these are commonly

found eight stamens, each of which has a very long anther, swinging (as it were) by its middle from the summit of the filament. The pollen of this tribe is peculiar in form, the grains being triangular, and cohering to each other by delicate threads. The ovarium, which will be found altogether below the flower, is four-sided, and contains four cells, in each of which are a great many ovules; from this a single style arises, which mounts through the tube of the calyx, and separates at the top into four stigmas. The fruit is a dry capsule with four angles, separating into four valves. The seeds of the Willow-herb are remarkable for the curious provision by which they are dispersed; each of them has a very long tuft of silk at one end, which is so light, that the faintest breeze is sufficient to buoy it up and carry it to a great distance.

600. Although several handsome species of this order abound in Britain and in other parts of Europe, it is in America that it is most predominant; and from that continent we have derived a plant of far greater beauty than any native species, which is one of the most splendid of the foreign ornaments of our gardens during the summer and autumn. This is the *Fuchsia* (pronounced Fushia), which, although at first introduced as a greenhouse plant, is now extensively cultivated in the open air, in the southern parts of Britain, and in sheltered situations in the north. "Every body," it has been remarked, "has Fuchsias; the poor weaver grows them in his window; many an industrious cottager shows them as the pride of the little plot of ground before his door; and even the suburban inhabitants of London speak of the beautiful Fuchsias they rear, with enthusiasm and delight." The calyx of this genus is of a deep crimson; and the petals, which are of a dark purple, are small, and rolled up within it. The fruit differs from that common to the order, in being a berry with a juicy rind, formed by the thickening of the pericarp, instead of being a dry capsule. This order has little, except its beauty, to render it interesting to mankind; for there is not a single species which possesses any particularly useful property.

601. The next important order is that of MYRTACEÆ, the *Myrtle* tribe, in the flowers of many among which, also, we find

the number four predominating; but it is not the number characteristic of the group. The leaves of the Myrtle and its allies are characterised by the same structure as that which has been noticed in the Orange (§ 563), being studded closely with little receptacles, which contain a volatile oil; so that, if they be held up to the light, they look as if pierced with holes closed up by a green transparent substance; and if bruised, they emit a fragrant aromatic odour. In the common Myrtle, as in most of the order, the calyx consists of five sepals, which adhere so as to form a tube; and within this, there is a corolla consisting of five small petals; the latter, however, is occasionally absent. Within the corolla, we find a considerable number of stamens, inserted on the summit of the tube of the calyx; their number is generally a multiple of that of the sepals, and they are sometimes united into bundles. The ovary of the Myrtle is divided into three cells, each of which contains a good many ovules; on this is mounted a single style, which ends in a very small stigma. The fruit is a purple berry, very much resembling that of the Fuchsia; but it contains only three cells instead of four.

602. In some species, however, the ovary is only two-celled, whilst the parts of the flower are arranged in fours. This is the case in the *Caryophyllus*, a tree of which the unripe flower-buds are known as *Cloves*. This tree is a native of the Moluccas and other islands in the Indian Ocean, from which it has been transported to several parts of the Continent of Asia, and also to the West Indies. It is only within a very limited range of Climate, however, that the Clove acquires its full aromatic flavour, so as to be useful as a spice; for even when grown in some of the larger islands near the Moluccas

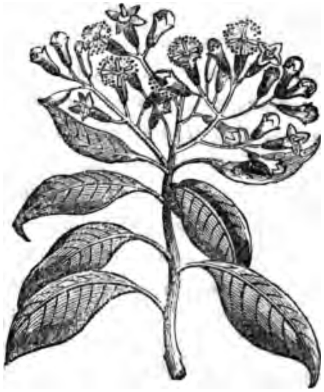

Fig. 89. Branch of Clove Tree, with Flowers and Buds.

and in Cochin-China, it is almost tasteless. The Clove has been known in Arabia from the earliest ages; and it was introduced into the European market nearly 2000 years ago. Up to a comparatively recent period, however, the source from which it was obtained was not known to Europeans. Early in the 16th century, the Moluccas were discovered by the Portuguese, and were soon afterwards taken from them by the Dutch, who endeavoured to monopolize the growth of the Clove, and to regulate the quantity which should be supplied, by cutting down or planting trees, according to their own supposed interests. This system more than once occasioned an insurrection among the natives, who regard the Clove-trees with great attachment, and who are in the habit of planting one at the birth of each child. Every part of the Clove-tree abounds with aromatic oil; but it is most fragrant and plentiful in the unexpanded flower-buds, in which it is so abundant that it may be pressed from them. It is one of the few essential oils that is heavier than water. It is a very powerful stimulant; and is sometimes employed in medicine; but its principal use is in cookery. The average annual crop of Cloves is from 2lbs. to 2½lbs. from each tree; but a fine tree has been known to yield 125lbs of this spice in a single season; and as 5000 cloves only weigh one pound, there must have been at least 625,000 flowers upon this single tree. The quantity imported into Britain in 1839 was upwards of 367,000lbs.

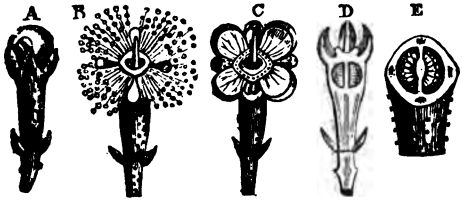

Fig. 90. Structure of flowers of Clove Tree. A, bud or Clove. B, the flower expanded, showing the stamens in four bundles, C, flower with stamens removed, showing the calyx and corolla, each consisting of four pieces. D, vertical section of ovarium. E, horizontal section of Ovarium.

603. Several other species of this order have aromatic properties, and yield products which are valued as spices. This is the case with the Pimento, the berries of which are known under

the name of All-spice, from being considered to unite the flavour of cloves, cinnamon, and nutmegs. They yield an oil which much resembles that of cloves. The pleasant fruits called the Rose Apple and the Jamrozade of the East Indies, and the Guava of the West Indies, are the succulent berries of shrubs of the Myrtle tribe; as is also the Pomegranate, which was originally a native of Barbary, but has now migrated to Europe. The volatile oil of Cajeputi is distilled from the leaves of an Indian species; this has long been known as a valuable external application in rheumatism; and, for a short time, it enjoyed the reputation of being a specific for the Indian Cholera. The leaves of another species are used by the Malays as tea.

604. There is a remarkable division of the Myrtle tribe, in which the fruit is dry, instead of being a berry, and opens at the top. The greater part of the species belonging to it are natives of New Holland; and amongst these may be specially mentioned the *Eucalyptus* or Gum tree. This is destitute of corolla; and the calyx has the sepals adherent very closely together, so as completely to envelope the stamens. When these expand, however, the upper part of the calyx separates from the lower, and is carried off upon the top of the stamens, very much as in the Eschscholtzia (§ 525). The Eucalypti are distinguished for their astringency; and the tannin which they yield has been extracted from their bark, and used in the manufacture of leather. An Indian species affords an astringent extract, which has been substituted for Kino.

605. This order is almost entirely restricted to warm climates. A large number of species is found in South America and in the East Indies; whilst, of the latter division of the group, a considerable proportion exists in New Holland and the South Sea Islands. The common Myrtle of this country is a native of the South of Europe; and it is well known that this beautiful evergreen is liable to great injury, and even to be destroyed, if not carefully protected from the cold of our severe winters.

606. The order CUCURBITACEÆ, or *Gourd* tribe, is not a large one but it contains several species which are highly useful to man,

such as the various kinds of Melon, Cucumber, Gourd, &c. These plants are all herbaceous, and grow by twining stems, which are furnished with tendrils. The flowers are very frequently monœcious or diœcious; but they are sometimes complete. The calyx and corolla are usually small, and the latter (as in the Cucumber) is not unfrequently absent, in which case the former assumes its appearance. Their parts are five in number, as are also the stamens, which very commonly adhere into a tube enclosing the style. The ovarium consists of three or five carpels united together; these are enveloped by the prolonged receptacle or fleshy tube of the calyx (just as in the Apple, § 595). The ovary, however, has only one cell, the partitions between the carpels having been obliterated; but in this single cell we may readily see, on cutting across a Cucumber, that the ovules are arranged on three lines which pass up the sides, and which are, therefore, parietal placentæ like that of the Heartsease. It is curious that, in the Melon and Cucumber, which are usually regarded as diœcious species, the development of staminiferous or pistilliferous flowers should be entirely governed by the degree of heat to which the plants are exposed; the former being produced when the proportion of heat to light has been considerable, and the latter under contrary circumstances. The plants of this order are almost entirely natives of hot climates, and can only be grown elsewhere under a considerable amount of artificial heat.

607. Although we are commonly accustomed to consider Melons and Cucumbers as quite free from injurious properties, (except in causing indigestion in weak stomachs), this character does not extend to the whole order. The bitter purgative drug termed Colocynth is obtained from the pulp of a sort of Gourd, which is a native of the Levant, Arabia, &c.; and from the Momordica Elaterium, or Spirting Cucumber, a still more active preparation has been obtained, a few grains of which are so violent in their operation as even to destroy life. This bitter purgative principle is not absent in the common edible fruit, but is present in smaller proportion. Besides furnishing palatable food, this order is very useful to man in supplying him with vessels of various forms and sizes. Some

gourds are nearly globular in form; and the rind, when the fruit is cut in half and the interior is removed, furnishes two basons. Others grow in the shape of bottles; and these sometimes attain the dimensions of six feet long by a foot and a half in circumference; when very young and small, they are made into spoons. Such vessels are known in the East and West Indies, Arabia, Egypt, &c., as *Calabashes*. Some of the fruits from which they are made are as harmless as the cultivated Melon and Cucumber; but others contain much of the bitter purgative principle; and, in preparing the latter, it is requisite not merely to scoop out the entire pulp, but to allow water to stand in them, and to change this several times, till all the bitterness be removed from the rind. The common *Pumpkin* is remarkable for its rapid growth; in good soil and well supplied with water, it will form shoots 40 or 50 feet long, and will cover an eighth part of an acre of ground in a season. Its pulp is eatable, but it is not much used in this country. On the Continent, however, it is frequently employed as an ingredient in various dishes; and it is extensively cultivated, for the purpose of feeding cattle and hogs, as well as on account of the seed, which yields an oil suitable both for food and for burning. The Vegetable Marrow, which within a few years has become a common dish, is the produce of an allied species of gourd. The Water Melon approaches in character to the Cucumber. Its fruit is so succulent that it almost melts in the mouth; and in warm climates or in hot seasons, is a most refreshing article of diet. To the Egyptians it may be said to be both food and physic. It often grows to a large size even in this country; but it is only between the tropics, that it attains its greatest dimensions; in Senegal, one has been known to weigh 60 lbs.

608. Very nearly allied to the Gourd tribe is the order PASSIFLOREÆ or *Passion-Flower* tribe, which also consists of plants having creeping stems, supporting themselves by tendrils, and bearing large juicy fruit. This order is principally to be met with in America; and its name is derived from the superstitious fancies, entertained by the Spaniards who discovered that Continent, respecting the flower which they considered to be an allegorical

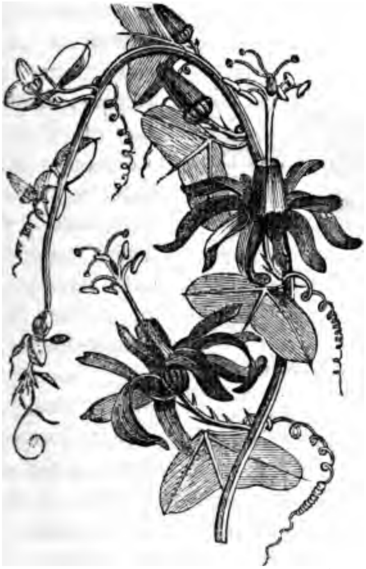

Fig 91. Branch of Passion-Flower.

representation of the crucifixion and sufferings of our Saviour. In its anthers, they saw his five wounds; in the three styles, the nails by which he was fixed to the cross; in the column which rises from the bottom of the flower, the pillar to which he was bound; and a number of little fleshy threads which spread from its cup, they compared to the crown of thorns. It seems difficult to imagine how such a notion could have been suggested to them; since the general aspect of the flower does not appear such as to be likely to excite it. Various species of Passion Flower ,are now naturalized in this country; and are beautiful ornaments to the fronts of houses, garden walls, or trellis work, over which they may be trained. They sometimes climb to the tops of high trees, and hang down in elegant festoons from their branches. On examining the flower, we find that the calyx has five sepals, which are usually green on the outside, but are yellow, red, blue, or purple in their interior. The petals are equal in number to the sepals, and are of the same colour with their inside; sometimes, however, they are absent. Next within these, we do not at once come, as we might expect, to the stamens; but we meet with several rings of beautiful fleshy threads, which spread from the calyx like rays, and are splendidly variegated with crimson or blue and white. These diminish in size towards the centre of the flower; and at last lose themselves as it were, in some little rings that surround the base of the column which now presents itself in the centre. These threads are to be regarded either as stamens or petals in an undeveloped state; it is of no consequence which we denominate them. In the centre of the flower, from the bottom of the calyx, rises a column; at the top of which we observe five anthers. The column itself, of which the outside resembles in colour the surrounding bodies, consists of an exterior sheath, formed by the adhesion of the filaments to each other, and of an interior solid stalk, on the top of which the ovary is mounted. The ovary when cut across, is found to consist of but one cavity; the ovules, however, are attached to three parietal placentæ (as in the Violet,) showing that the seed-vessel is composed of three carpels; and the summit of the ovarium bears three short styles, wich terminate in thick swollen stigmas. The fruit is a fleshy egg-shaped body, containing a number of pulpy seeds; but it varies extremely in size and colour in the different species. In all instances, however, it is destitute of any injurious principle, and may be eaten with safety. In the common Passion-flower, it is about as large as a hen's egg, and orange yellow on its exterior; in some tropical species, called *Grenadillas*, it is much larger, attaining the size of a man's head, and is greener in its colour. These are cultivated on account of the slightly acid pulp they contain, which renders them refreshing; and the rind, which is also a little acid, is cut into slices and made into tarts which have somewhat the flavour of those of apples. The substance which surrounds the seeds is not mere pulp, but is

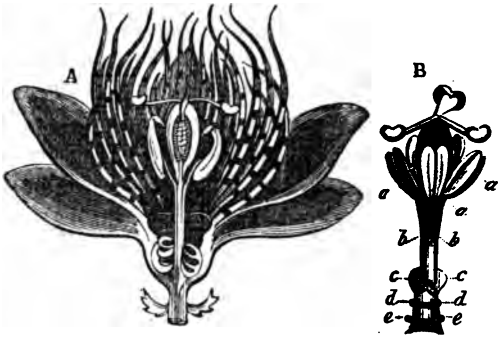

Fig. 92. A, section of Passion-flower. B, central column, showing the 3 styles at the top; the five anthers *a*, *a*; the tube, *b*, *b*, formed by the cohesion of the filaments; *c*, the innermost ring of the undeveloped petals; *d*. the origin of the petals; *e*, the origin of the calyx.

a sort of fleshy coat, termed the *arillus*, which gradually rises from the bottom of the ovule, and at last envelopes it completely. It will hereafter be seen that the spice known as *mace* is the arillus of the nutmeg. A species of Passion-flower inhabiting the Isle of France is remarkable for the narcotic properties of its root; but it is not unlikely that these are shared in some degree by others.

609. Passing over several small orders, we come to that of CRASSULACEÆ, the *House-leek* tribe, which is chiefly interesting as containing several British species of succulent plants, which flourish under circumstances that would be fatal to almost all others. They are found in the driest situations, where not a blade of grass nor a particle of moss can grow, on naked rocks, old walls, sandy hot plains, alternately exposed to the heaviest dews of night, and to the fiercest rays of the noon-day sun. Soil is to them something to keep them stationary, rather than a source of nutriment. In this respect they resemble the Cacti and other plants of tropical climates, which they represent in more temperate regions. About half of the species known to Botanists are natives of the Cape of Good Hope; and nearly half the remainder are European plants. Although they resemble the Cacti, and some other orders, in the succulent nature of their stems and leaves, there is no other very close correspondence between them. The number of parts in the flower is subject to great variation. The calyx may consist of from three to twenty sepals, which are united at the base. The petals are equal in number to the sepals, and are inserted into the calyx; they are sometimes distinct, and sometimes cohere into a monopetalous corolla. The stamens are either equal in number to the petals, alternating with them; or are twice as many, in which case those alternating with them are longer and come to maturity earlier than the others. The carpels are equal in number to the petals, and are opposite to them; they are arranged in a circle, and are more or less adherent in different species, each having its own style and stigma. Every one contains several ovules, which are arranged in two series along its internal edge, where the dehiscence or opening usually takes place at the time of maturity. The *Sedums* or Stonecrops, of which many

species exist in Britain, belong to the Linnæan class and order DECANDRIA *Pentagynia*, having five parts in the calyx, corolla, and ovarium, with double the number of stamens; whilst the *Sempervivum*, or House leek, is found under DODECANDRIA *Dodecagynia*, having twelve stamens and twelve styles. The common British species of the latter is remarkable for almost always bearing ovules on its anthers, instead of pollen. These plants are not only very tenacious of life when naturally exposed to the elements, but resist efforts made to destroy their vitality, when it is desired to preserve them. The collector finds it very difficult, therefore, to prepare them for his Herbarium; for they will push long shoots whilst under great pressure, and after being submitted to a high temperature. It is from the deficiency of stomata, and the thickness of the cuticle, that it is so difficult to dry them; and it is obviously by these properties, that they are enabled to resist the rays of the sun.

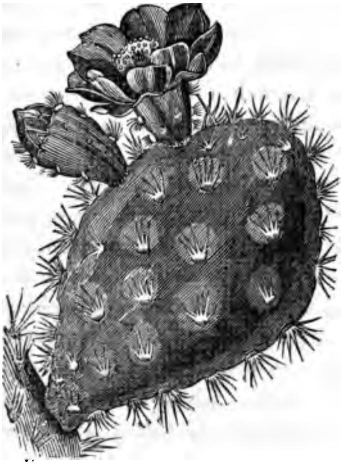

Fig. 93. Stem, branch, and flower of Cactus.

610. The order CACTEÆ, or *Prickly Pear* tribe, is by nature exclusively confined to the New World; but several species have now been naturalized elsewhere. They do not, even on that continent, extend far from the tropics they frequent hot, dry, exposed situations, like those to which the Crassulaceæ are adapted. Most of the species of this order are remarkable for the absence of leaves, of which no other traces are found than tufts of prickles arising at regular intervals from the stem,—these being the veins of the leaves between which the parenchyma is not developed (§ 236). The stems and branches are very fleshy and succulent, and usually have flat expanded surfaces, which in some degree perform the functions of leaves. In

the various species of Cactus, however, we find the form of the stem differing greatly. Thus in one kind, known as the Melon Cactus from its form, the stem is so much stunted as well as expanded, that it quite resembles the fruit alluded to. In other species, however, the stems are round and greatly prolonged, resembling ropes; whilst in others, again, they are equally long, but are angular. All are adapted to the same circumstances of growth; but the Melon-Cactus, from its greater bulk, in proportion to the surface it presents, can exist in the most exposed situations. It usually happens in tropical climates, that during a certain portion of the year, a large quantity of rain falls, the atmosphere is loaded with dampness for many weeks, and the soil is completely saturated with water. During this time, the Cactuses live very fast, and distend all the cavities of their tissue with fluid. The resistance afforded by their thick cuticle, and by the deficiency of stomata, to the evaporation of this, enables them to retain a store of it (as the Camel holds water in the stomach) until they can acquire a fresh supply. At other times, they may be said to live very slowly; the functions of exhalation, digestion, &c., are performed very inactively; and the fluid which they have absorbed during the rainy season is adequate for their support, during all those months when they cannot live upon the soil or the atmosphere. This property sometimes renders the Cactus tribe of great utility to man. On Mount Etna, for example, and its volcanic fields, it is the *Indian Fig* which the Sicilians employ, to render such desolate regions susceptible of cultivation. This plant readily strikes into the fissures of the lava, and soon, by extending the ramifications of its roots into every crevice of the stone, and bursting the largest blocks asunder by their gradual increase, makes it capable of being worked. The juiciness of the stems causes them to be sought in the West Indies, during dry seasons, by the cattle, which, tearing off the thorny integument that covers them, feed upon the moist pulp within.

611. The flowers of this tribe are commonly very showy; and the number of handsome species, which have been of late introduced into our hothouses, gives them an air of splendour unknown

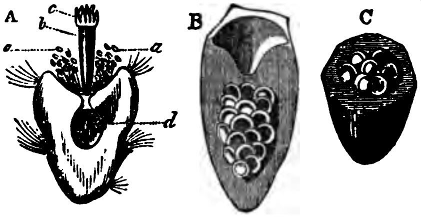

Fig. 94. Parts of flower of Cactus tuna. A, thickened axis, bearing the Stamens, *a*,—the style, *b*,—and stigma, *c*; and enclosing the ovarium, *d*. B, vertical section of ovarium. C, transverse section of ditto.

until recent years. No distinction can be traced between the calyx and corolla; for the flowers branch off directly from the stem; and its cylindrical axis is covered with scale-like coloured bracts, which at the upper part gradually pass into thin delicate petalline leaves, which unfold, tier after tier, from within each other, adhering by their lower ends so as to produce a firm fleshy tube. From the interior of this tube spring a number of rows of slender stamens. The ovarium is situated in a cavity within the apparent stalk of the flower; and contains a considerable number of ovules, attached to parietal placentæ. The style is a single column, springing from the top of the ovarium; and, after rising above the anthers, it divides into a star-shaped set of stigmas, equal in number to the placentæ. The beauty of the flowers is usually very short-lived; some of them only last for a few hours. One of the most splendid species is the *Cereus grandiflorus* or night-blowing Cereus, the blossoms of which begin to expand about 6 or 7 o'clock in the evening, and are fully blown about midnight; but, by 3 or 4 in the morning, they are quite decayed. During its short continuance, however, there is scarcely any flower of greater known beauty. The perianth, when open, measures nearly a foot in diameter; the outer leaflets are of a dark brown colour, the inner ones are of a splendid yellow, gradually shaded, towards the centre of the flower, into a pure and brilliant white. When several of these magnificent flowers, therefore, are open at once upon a single plant, they seem like stars shining out in all their lustre, verifying the poet's declaration that

> " Darkness shows us worlds of light
> We never see by day."

Besides possessing beauty for the eye, these flowers are delightfully fragrant, and fill the air with odours to a considerable distance around.

612. When the flower has withered, the ovary enlarges and becomes pulpy, and is in time converted into a fruit which has much resemblance to that of a gooseberry, but is usually inferior in flavour. The juiciness of the fruit of many species, however, renders them acceptable in warm climates; on Etna, for example, the large cooling fruits of the Indian Fig are sold in considerable quantity, and some of the varieties are of great excellence.* Independently of this use, the Cactus tribe cannot be said to be of any direct advantage to man; they indirectly serve him, however, in a very important manner. Several species of the order are infected with insects of the genus *Coccus*, some of which, especially the *Coccus Cacti*, become, from the colouring matter they collect from the fruit and flowers of the plant, of great commercial importance, being, in fact, the *Cochineal* of the painter and dyer. One particular species of Cactus contains a red juice more delicate than the others; and it is when feeding on this, that the bodies of the Insects acquire the most brilliant tinge. Cochineal consists of nothing else than the dried bodies of the Insects, which are impregnated throughout with this colour.

613. The next order to be noticed is that of the GROSSULARIÆ or *Gooseberry* tribe, which is nearly allied, in the structure of its flowers and fruit, to the Cacteæ, and may be regarded as representing that order in cold climates. Although the stems of this tribe are not succulent, nor their leaves entirely deficient, yet there is a conversion of many leaves into spines, by the absence of their fleshy part. If the flower of the common Gooseberry or Currant be examined, the following will be found to be its structure. The calyx is a little globular cup, green without and purple within;

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* It will serve to show the remarkable combination which exists between different organs in this order, to state that the Author has witnessed an instance in which the *fruit* of a Cactus sent forth a regular branch, which exactly resembled those proceeding from the stem.

its border is marked by five indentations, which show it to consist of five sepals. At its mouth are five small scales, which are the petals; and between these are the stamens, which are also five in number. In the centre of these will be seen a single style, cleft at the top into two small stigmas; and these arise from an ovary which is situated below the calyx, imbedded, as it were, in the flower-stalk, very much as in the Cacteæ. The ovary is one-celled, and contains a considerable number of ovules, arranged upon two parietal placentæ. When the flower has withered, the ovary swells, and becomes filled with a pulpy substance which surrounds the seeds; it is by the remains of the calyx, that what is known as the *eye* of the gooseberry is formed. If a ripe Gooseberry be divided into two parts from its point to its base, the position of the seeds, and their attachment by threads to its walls, will be seen to correspond with what has been said of the structure of the ovarium.

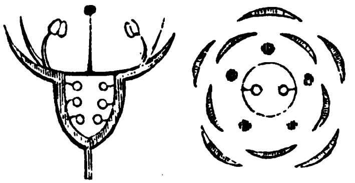
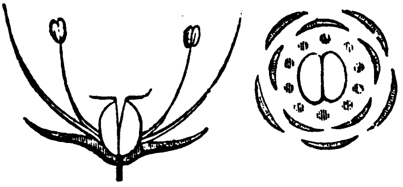


Fig. 95. Diagram of flower of Grossulariæ.

614. The description just given of the flower of the common Gooseberry is not entirely applicable to every species; for in some the petals are entirely absent; and in others, the calyx is brilliantly coloured, as in the Fuchsia. Currants, as well as Gooseberries, belong to this order; indeed, the botanical difference between the two is extremely slight. These fruits only attain their true perfection in temperate climates; and it is probable that they are nowhere produced of equal size and flavour to those which are raised in Britain. It is not uncommon for them to attain the weight of from an ounce to an ounce and a half. In Spain and Italy, the heat of the summers is too great for the due development of the fruit; these plants not being provided, like the Cactus tribe, with the means of resisting it. All the different kinds of Gooseberry are varieties of one species; and the same may be said of the Red and White Currant; but the Black Currant is a distinct species, of which no varieties have been obtained. The latter

grows wild in Russia, where the juice of its berries is made into wine; and in Siberia the leaves are used as tea. Various species of this order are found in North America; and some are particularly abundant on the mountains of Northern India, giving quite a European character to that region.

615. The succeeding order, SAXIFRAGEÆ, or *Saxifrage* tribe, chiefly deserves notice on account of the number of species it contains, which present themselves in cold and mountainous countries, occupying the sides and even the summits of lofty hills, the tops of walls, the depths of wooded dingles, the sides of trickling streams, and even the recesses of the most dreary bogs. Their flowers are remarkable for their exquisite neatness, and for the purity of their colours. One of the best known species is the *London Pride*, which, although a native of the Yorkshire and Irish mountains, endures without injury the smoke and impure air of the metropolis; from which circumstance it derives its name. It is met with in cottage gardens almost as frequently as are daisies and primroses. The *Hydrangea* is another species cultivated in gardens; and this is remarkable for the circumstance of the showy part of the flower consisting really of bracts. The calyx, in the *Saxifrage tribe*, usually consists of five sepals, more or less adherent to each other and to the ovarium; the number varies, however, in different species, from three to seven. The number of the petals is ordinarily equal to that of the lobes of the calyx; and that of the stamens is either the same or double. The ovarium consists of from two to five united carpels; the partitions between these are sometimes complete, forming a two, three, four, or five-celled ovarium; but occasionally they are absent, so that it is one-celled. The styles are commonly distinct, but are sometimes adherent; in the greater number of the tribe there are no more than two, indicating that the ovarium is made up of but two



Fig, 96. Diagram of flower of Saxifrageæ.

carpels. Each cell contains a large number of minute ovules. The fruit is ordinarily enclosed in the calyx, and opens only at the point. There is one genus, however, in which there is no adhesion between the calyx and ovarium; and there are several in which the adhesion does not extend far up. The structure of the fruit a good deal resembles that of the Rosaceæ.

616. The plants of this order are almost universally diffused over the globe; but they cannot be said to be of any direct utility to man. The name of the principal genus, *Saxifrage*, however, is probably derived from the power which may be attributed to the plants composing it, of breaking up the surface of the rocks on which they grow, by insinuating their roots into crevices, and afterwards causing them to distend, in the same manner as the Cacteæ have been spoken of as doing (§ 610). If this idea be correct, it is obvious that their function, in preparing the surface of barren rocks and mountain sides, for the habitation of plants of a higher order, is one of the most important in the whole economy of nature. At least twenty species of this genus alone exist in Britain; and some or other of them are found in almost every rocky or exposed situation. To this order belongs the very singular genus *Parnassia* (so named because it is said to abound on Mount Parnassus), the British species of which is the companion of the Sun-dew in its marshy haunts, and rivals it in singularity of structure. In the latter, the peculiar glandular hairs are found only on the leaves; but in the Parnassia they exist on the flowers. Alternating with the stamens, there are five fleshy scales, divided at their edge into numerous rays, each of which is tipped with a beautiful pellucid greenish gland; so that the flower, when viewed from above, appears set with sparkling jewels. The *Hydrangeas*, (which are not natives of Britain, but have been introduced from China and Japan,) are also marsh plants, and should be kept well supplied with water, when grown in gardens. A full-sized plant requires as much as from 10 to 12 gallons daily in warm weather. When the floral envelopes are over developed by cultivation, the flowers become barren, and the plant must be propagated by cuttings. They grow in closely-set clusters; and a little examin-

ation of one of these will often disclose many curious irregularities, produced by the partial union of two or more flowers, arising from the want of room for their full development. The regular number of the large coloured leaflets is four; but not unfrequently we find a flower possessing five, six, seven, eight, or even more; and the additional ones are easily shown to be derived from other flowers, which are partially *fused*, or melted down as it were, into the first. The Hydrangeas are likewise remarkable for the varieties of colour to which the same species, or even the same individual, is subject, according to the soil in which it grows. Their natural and most common colour is red; in a poor soil, however, they become of a dingy green; but when grown in richer mould, especially in peat-earth, and watered with an alkaline solution, or manured with wood-ashes, they assume a rich blue tint, and their clusters increase in size and present a very handsome appearance.

617. We next come to an order of great extent and importance; and one that is marked by an evident peculiarity, which enables us to distinguish very readily, in almost every instance, the plants that belong to it. This is the order UMBELLIFERÆ, the *Umbelliferous* tribe, so named from the peculiar arrangement of the flowers upon the stem, which pervades the whole group. If we look at a plant of any common species, such as the Parsley or Hemlock, we observe that the flower-stem divides at the top into a number of short slender rays, which all proceed from one point, just as do the stretchers of the umbrella. If the flowers were borne on these, the whole set would be considered as forming a *simple umbel*, such as we find in the Geranium and many other plants. But in the Umbelliferæ, we commonly find that each stalk of the umbel subdivides again, bearing second set of rays that carry the flowers at their extremities, which itself constitutes an umbel. The whole system is then termed a *compound umbel;* and it is this which is characteristie of the order. It may be further noticed, that the stems are almost always hollow, and that the leaves are usually much divided.

618. The separate flowers are generally very minute, and require good sight, or the aid of a magnifying-glass, for their parts to

be distinguished. The calyx generally appears very small, seeming to consist only of a little narrow border, from within which the petals arise. This border is marked, however, by five indentations, showing that it consists of five adherent parts or sepals; and these adhere not only to each other, but to the ovarium (which is consequently inferior), so that their points only are free, and these seem to spread out from the summit of the seed-vessel. The petals are five in number, and spring from the top of the tube of the calyx; between these arise five stamens. In the centre of the flower we observe two styles; and these arise from the top of the ovary, which is two-celled, each cell containing but a single ovule. These characters are so constant, that very nearly the whole of the order is contained in the Linnæan class and order PENTANDRIA *Digynia;* the only exception being in a few species, in which the ovarium is made up of *three* carpels. As the fruit ripens, the seeds become adherent to the walls of the ovary; and the two divisions of the latter separate from one another; so that instead of a fruit, we find two grains, which seem like seeds, and are commonly considered as such, although really consisting of the carpels enclosed in the tube of the calyx. They are frequently marked in a curious manner on the outside, by ribs or nerves which belong to the latter; and it is in the substance of this envelope, that the little receptacles of secretion exist, which contain the essential oils that are characteristic of the grains of this order, such as those of Anise, Carraway, &c.

619. The strong general resemblance which exists between Umbelliferous Plants makes it frequently a matter of some difficulty to distinguish their various genera and species. This is the more to be regretted, as there is a great difference in their respective qualities, some being nearly or quite harmless, whilst others are virulent poisons. The Carrot, Parsnep, Celery, Fennel, Parsley, Carraway, Dill, Anise, Coriander, and Samphire, are all well-known kinds, which are useful for various purposes,—the three former being very largely cultivated, as affording important articles of food; whilst, on the other hand, the group contains the Hemlock, Cowbane, Dropwort, Fool's-Parsley, and many other species, which

are more or less unwholesome. The fact is, that the general character of the order is to possess narcotic and acrid qualities, which are especially abundant in some species, and which probably exist, in some degree or other, in all. In regard to the Carrot, and Parsnep, the same remark applies, which has been formerly made (§ 659) respecting the Potatoe;—that the edible portion consists principally of starchy matter deposited for the nutrition of the growing parts, and that this is consequently free, or nearly so, from the peculiar properties which characterise the order. The Celery, when growing in its usual manner, possesses these properties in a degree which would render it injurious as well as disagreeable to the taste; and it is only by being blanched (§ 288) that it is rendered palatable and wholesome. The Fennel and Parsley, of which the leaves are employed to flavour various articles of cookery, are by no means devoid of injurious properties, though the small quantities in which they are usually eaten does not cause these to be manifested; the latter is said to be much more injurious to Parrots, than it is to man or cattle. These properties are generally contained in the leaves and stems alone; and consequently the fruit even of the poisonous species are for the most part destitute of them, and may be used as aromatics.

620. Of the British species, the only one of which the juices are ordinarily used for medicinal purposes is the *Conium maculatum*, or Hemlock, which derives its specific name from the spotted appearance of its stems, by which it is easily recognized. Although the order is more abundant in temperate climates than between the tropics, there are certain plants of warm climates which afford medicinal products of great value, known under the names of the *fœtid gums*. They are of the nature of Gum-resins (§ 378), and are distinguished by their powerfully-disagreeable odour. Those most in use are Assafœtida and Galbanum, which are procured from Persia and the East Indies, and are remedies of great utility in hysteric and spasmodic complaints. The geographical distribution of this order presents some points of much interest. Out of about 900 species, which it was estimated

some time ago to contain, nearly three-quarters are inhabitants of the Northern Hemisphere; and of these, by far the larger proportion belongs to the Old World. In the whole of America there are but about 160 species; whilst in the extensive wastes of New Holland, and in the numerous islands of the Polynesian Archipelago, only about 70 are known. The number in Britain alone is not less than 66.

621. The order LORANTHACEÆ or *Misseltoe* tribe may be next briefly noticed, chiefly on account of the curious habits of the numerous species it contains, which are nearly all parasitic upon other plants; forming, like the Misseltoe, natural grafts with them, by insinuating their roots into their chinks, and deriving from them the supply of sap afforded by the ascending current (§ 320). The calyx of their flowers is adherent to the ovarium, and scarcely exhibits any trace of division into sepals; its tube is enclosed at its base between two bracts. The corolla is formed of from 4 to 8 petals, more or less united at the base. The stamens are equal in number to the petals, and are opposite to them; their filaments are usually adherent to the petals; but sometimes they are absent, so that the anthers are seated, as it were, upon the latter. The ovarium is one-celled, and contains but a single pendulous ovule; there is only one stigma, and the style that should support this is sometimes absent. The fruit is a berry, containing a viscid matter, like birdlime; it is frequently eaten by birds, which drop the seed on the trees on which they perch; and this, by the peculiar direction of its germination. (§ 321) insinuates its radicle into their stems or branches

622. The principal genera of this order are the *Viscum* and the *Loranthus*. The former only inhabits Britain, and is known as the Misseltoe; it is generally found parasitic upon trees of the order Rosaceæ, such as the Hawthorn and the Apple; and it rarely occurs on the Oak. Hence it probably was, that, when growing on the latter tree, it was held in superstitious veneration by the Druids of old. The Loranthus, on the other hand, infests a great variety of trees, each of these having, for the most part, a particular species which grows on it alone. Above 250 species of

it are known; and these are mostly found in the tropical parts of America and India. In Africa, and in the South Seas, they appear to be very rare.

623. The next order, Caprifoliaceæ, or Honeysuckle tribe, bears a nearer relationship to the foregoing, than might have been suspected. The flower chiefly differs from that of Loranthaceæ in the stamens being alternate with the petals, instead of opposite to them; and the ovarium frequently (but not always) contains more than one cell. The order differs, also, in the absence of parasitic habits. To this group belong not only the Honeysuckle but also the Elder, and, in the opinion of some Botanists, the Ivy; as also the Guelder-Rose and Laurestinus, the latter of which is a beautiful garden shrub, bearing leaves and flowers all through the winter. All these plants are natives of the northern parts of Europe, Asia, and America; they are less abundant as we approach the tropics, and are almost unknown in the southern hemisphere. The flowers and leaves of most of this order are strongly odoriferous; the former are generally very fragrant; but the latter are frequently (as in the common Elder) fœtid, and possessed of acrid properties. The bark is generally astringent; that of some species has been used for tanning; and that of others has been employed in medicine for the same purposes, and with similar effects, with Peruvian Bark. The berries of the Elder and of other species contain a good deal of sweet juice, which may be fermented into a kind of wine. Those of an American species, when dried and wasted, furnish the best of all substitutes for Coffee, which is afforded by a plant belonging to the succeeding order. Another species, known as the Snow-berry, is cultivated in gardens on account of the delicate white colour of its fruit.

624. The next order, Rubiaceæ, or *Madder* tribe, is a very extensive one, but is almost entirely confined to tropical countries. It comprehends the meanest weeds and the noblest flowering trees,—obscure herbs with blossoms which it almost requires a microscope to detect, and bushes whose scarlet corollas are many inches long; and includes a plant which affords one of the most grateful beverages that the luxury of man has prepared, with others of

nauseous and bitter taste, some of which, in skilful hands, are most valuable medicines. The Rubiaceæ and Caprifoliaceæ differ essentially in little else than this,—that the former possess stipules at the base of the leaves, of which the latter are destitute. The calyx of the former consists of a cup, enclosing the ovarium, and scarcely divided even at its edge. The petals of the corolla are adherent at their lower part into a tube; their number is usually five, but varies from 3 to 8, as does also that of the sepals. The stamens are equal in number with the lobes of the corolla, and are alternate with them; they are generally adherent to the lower part of the tube. The ovarium usually contains two or many cells; the style is single, but is divided at the top into a number of stigmas equal to that of the cells. The fruit is commonly a berry containing several seeds, enclosed in a fleshy covering; or it may be a hard capsule merely; or only one seed may have ripened, which is enclosed in a flesh, forming a *drupe*, like the Plum. The albumen of the seed is of a horny texture—a peculiarity that is well exhibited in Coffee, which consists of the seeds divested of their envelopes.

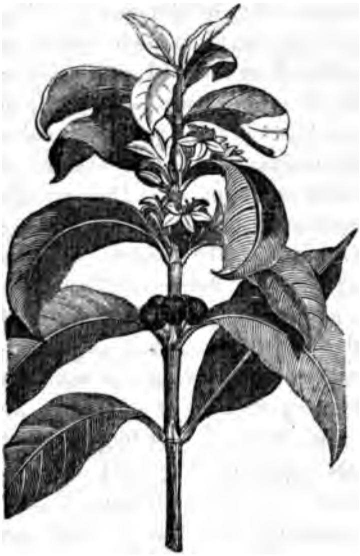


Fig. 97. Coffee Plant, showing the flowers and berries, and the stipules at the base of the leaves.

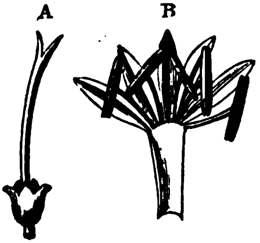


Fig. 98. Part of the flower of Coffee Plant. A, calyx inclosing ovary, with bifid style. B, tube of the corolla cut open, showing the five divisions of its upper part and the five stamens arising from it.

625. Coffee might be obtained from several species of the genus *Coffæa;* that derived from one, however, is so superior to the rest, that it alone is commonly cultivated; and numerous varieties of it, depending in part upon soil and climate, are now known. The native country of the Coffee Plant is Arabia; and the use of its seed as a nourishing and agreeable beverage, has been traced to a remote period, this having been certainly employed in Persia as far back as the year 875. It was not introduced into Europe, however, before the year 1517; and it was a century and a half before it came into general use, even in the Capitals, where Coffee-houses were established. The seeds were at first sold at an exorbitant price,—as much as four or five guineas the pound. The plant was introduced into the West Indies by Louis XIV., from a specimen presented to him by the Dutch, in 1714, of which he sent offsets to Surinam, Cayenne, and Martinique; and from this all the present plantations are descended. The East India plantations were derived from a similar common source,—a plant in the Botanic garden at Amsterdam, which had been raised at Batavia, from seed procured from Mocha, in 1690. The Mocha berries are smaller and possess a higher flavour than those which are brought from the West Indies. This is partly due to the difference of soil and temperature, and partly to a difference in the mode of culture. It would seem as if nearly the same quantity of the aromatic product were formed in each case; but that, in the large seed it is diffused through a greater quantity of the tasteless albumen, and is therefore less intense. It has been confidently asserted that, if the West Indian Coffee be kept for several years, instead of being roasted and consumed as soon as it can be transported across the Atlantic, its flavour improves, and becomes equal to that of the best Mocha.

626. The Coffee-tree grows erect, with a single stem, to the height of about 8 or 10 feet, and has long undivided slender branches, not unlike those of the bay-tree. The blossoms are white, and are seated on short footstalks, altogether resembling the flowers of the Jasmine. The berry is red, resembling a cherry, and having a pale, insipid, and somewhat glutinous pulp, enclosing

two hard nearly hemispherical seeds, of which the flat sides are opposed to each other; the seeds are enveloped in a membrane, which resembles that forming the divisions of the core of the apple, and is called the parchment. The trees begin to produce berries when they are two years old; and in their third year they are in their full bearing. The blossoms expand very rapidly,—those of a whole plantation sometimes coming out in a single night, but they fade almost as rapidly. The pulp is separated from the berries, when these have ripened and have been gathered, in various ways. By some the berries are exposed to the sun, until they are perfectly dry, and the hardened pulp forms a husk, which is broken away with rollers. By others, the berries are exposed to the sun in layers, so that the pulp is caused to ferment. And by others, again, it is rubbed off in a sort of mill. The seeds, before being roasted, are nearly tasteless; but during this process, a change seems to take place in the chemical arrangement of their particles, which produces the aromatic flavour and odour so highly valued.

627. When Coffee was first introduced in Turkey, the use of it was forbidden by the government, on the ground of its being an intoxicating beverage; and the ministers of religion complained that the people forsook the mosques and crowded to the coffee-houses. It has since become, however, quite a necessary of life in Turkey; so that at one time the refusal of a husband to supply his wife with a reasonable quantity of it, was reckoned amongst the legal causes for a divorce. The history of the present large demand for it in this country is very remarkable. In 1808, when the duty on coffee produced in British plantations was two shillings a pound, it was beyond the reach of the poorer classes of consumers. The total quantity consumed in Britain was then little more than one million pounds, from the importation of which the Government derived a revenue of about £.160,000. But in 1824 the duty was lowered to sixpence a pound; and the consumption has gradually increased to nearly 27 million pounds, producing an import duty of £.780,000. There are strong reasons of a moral nature for encouraging the consumption of Coffee, by cheapening

its price to the lowest amount; for it has been satisfactorily shown that the more extended use of it has mainly contributed to promote improved habits amongst large classes of the community.

628. The order Rubiaceæ takes its name from the *Rubia* or Madder plant, which furnishes the most important of our crimson dyes (§ 392). It is only in tropical countries, however, that it presents its finest aspect; but in some of these it is so predominant, that its species constitute about 1-29th of the whole number of flowering plants. Amongst the most important of these are the *Cinchonas*, which furnish the Peruvian or Jesuits' Bark so largely used in medicine. This is very astringent, and might be used for tanning; but its chief peculiarity consists in containing a large quantity of an alkaline substance termed *quinine*, which may be extracted from it by chemical means, and which, being the most valuable part of the drug, is now usually given in a pure state. This is almost a specific for agues; and is extremely valuable as a tonic in weakened states of the system. The Cinchonas, of which the various species afford this product in varying degrees, grow in extensive forests in South America; chiefly inhabiting the sides of the range of the Andes, between 10° North Lat., and 22° South Lat., and sometimes rising on these mountains to the height of 10,000 feet. It is from the trees growing in elevated situations that the best bark is derived. Another most valuable remedy afforded by this order is Ipecacuanha, which is the powdered root of a little creeping-rooted, half-herbaceous plant, found in damp shady forests of Brazil. This is chiefly employed in medicine as an emetic, and also to produce perspiration; but it has several other important uses.

629. Passing over several orders of secondary importance, we come to one alike remarkable for its peculiarities of structure, for the large number of plants contained in it, and for the variety of size, colour, properties, &c, which these exhibit. The order alluded to is that of Compositæ or *Composite* plants, so named on account of the manner in which a number of flowers are clustered together so as to form one which is apparently single. We are in the habit of speaking of the Daisy, the Dandelion, the Sun-flower,

the Dahlia &c, as single. flowers; and yet every one of these is really composed of a *head*, on which a large number of blossoms are crowded together. If any one of these be examined in its natural state (that is, not affected by cultivation,) it will be found to consist of the following parts. In the first place, the flower-stalk spreads out into a large fleshy expansion, which is the disk or receptacle of all the florets united. Around the edge of this, we notice a whorl of small green leaflets; these are bracts, and the whole circle is termed the *involucrum*. Above and within these, we notice one or more whorls of flat leafy coloured organs, which at first sight appear to be single petals, but which will be presently shown to be so many distinct florets, of which the corolla has expanded itself on one side only. In the wild Daisy and Sunflower, only one whorl of these exists; but in the cultivated Daisy, as in the Dahlia, they become numerous, from a cause that will immediately appear. Within these we find, crowded together upon the disk, a large number of minute flowers, scarcely having any perianth. That these are really such, can often be only distinctly seen with a magnifying glass. Every common Daisy of our meadows contains between two and three hundred such florets, each perfect in itself, that is having its corolla, stamens, pistil, and fruit. These central florets are termed *florets of the disk;* in them the floral envelopes are but little developed, whilst the organs essential to reproduction are complete. On the other hand, the flat leaflets by which they are surrounded are called *florets of the ray*, from the radiating manner in which they are set on the receptacle; in them, the corolla is developed at the expense of the reproductive organs, one or both sets of which are usually absent. If one of them be pulled up carefully at the end by which it was fastened to the flower, it will be seen that it is not flat at the bottom, as it is at the top, but that it becomes tubular; and that a little thread ending in two horns, issues from the tube; this thread is the forked style, the stamens being here deficient. The coloured perianth in both these classes of flowers is evidently to be regarded in the light of a corolla; where, then, is the calyx? In the Daisy none is to be found; but in the Dandelion and many other Composite plants, we may observe that, on rooting up each floret from the receptacle, a few little narrow hairy scales are attached to their lower end, forming a sort of down; and this down is the only representative of the calyx. We shall presently see that it has an important function to fulfil, where it is present. Below the pappus is the ovary, which is one-celled, and contains but a single ovule. The corolla of the florets of the disk is tubular from the bottom to the top; at the top it widens, and is cleft into five little divisions, indicating that it consists of five adherent petals. The style terminates in two stigmas, which project beyond the mouth of a little hollow cylinder that is found at the orifice of the flower. This cylinder, when examined with a magnifying glass, is found to consist of the anthers, which adhere together, side by side, so as to form a tube; in other respects their structure does not differ from their usual character. The nature of this cluster of flowers may be better understood, by comparing it with an umbel, of which the radiating stalks have not been developed, so that the flowers which should be borne on them are all crowded together at the summit of the flower-stalk, from which these branches should have arisen. The fruit of each flower is a little grain, looking like a seed, but really consisting of a seed enclosed within the ovary. When the downy calyx exists, it remains attached to this, and forms a feathery plume, by which it is wafted through the air; and thus the seed is diffused and scattered by the wind. Every child who blows the delicate feathery balls of the Dandelion, thus assists in the multiplication of the plant; which it is very difficult to eradicate, when once it has gained a footing in a neglected garden, on account of this curious provision.

630. This order is one of verygreat extent, containing many thousand species; and it is desirable to state its principal sub-divisions, as these may be recognised, by examining the commonest British species, as readily as may the characters of the order itself. Such florets as exist in the ray of the Daisy, Marigold, &c., are technically called *ligulate* or strap-shaped, from their flattened aspect Now in the Dandelion, it will be found that both the ray and the disk are composed of ligulate flowers, to the entire exclusion of

the tubular ones; such plants are ranked in a group named *Cichoraceæ*, from the common Cichory or Succory, with which they all agree in possessing a milky juice; and this, when concentrated, is found to have narcotic properties. This group contains a large number of our wild flowers. From these will easily be distinguished the group of *Cinarocephalæ* or Thistle-headed plants, which have, like the Thistle, a head of flowers, composed entirely of tubular florets, and of an almost hemispherical form; these are further distinguished, for the most part at least, by their hard and spiny leaves. To this section belongs the *Artichoke*, which is cultivated for the table, on account of the fleshiness of the scales or bracts, which form the involucrum; the fleshy bottom of these is the receptable; and the choke, which is thrown away, is a collection of florets separated from each other by numerous stiff hairs. The third section contains those Composite plants which contain both sorts of florets,—ligulate ones in the ray, and tubular ones in the disk; hence they are called Radiate flowers or *Corymbiferæ*. It sometimes happens that no ray is present; but the heads of tubular flowers cannot then be mistaken for those of the last section, since the florets of the latter are very wide-mouthed, and spread over the sides of the involucrum, the bracts of which are hard and spiny,—whilst in the former case, the tubular flowers are narrow at the mouth, and are not longer than the scales of the involucrum, which are sof and leafy. To this Radiate group belongs the Sun-flowers, Chamomiles, Daisies, Marigolds, Groundsel, Wormwood, the beautiful tribe of Asters which add so much to the splendour of our gardens, and thousands of other species.

631. It must not be supposed that the clustering together of the florets in heads is so essential a character of this order, that every plant in which it exists is to be regarded as belonging to the Compositæ. The contrary is the fact; for although no plants of this order have other than composite flowers, there are several in other orders, in which the flowers grow in heads. The most important single character is the adhesion of the anthers into a tube; such perfect adhesion presenting itself nowhere else. Upon this is founded the

Linnæan name of the group which corresponds with the order Compositæ,—the class SYNGENESIA. In the whole of the subdivision *Cichoraceæ*, all the florets are complete, possessing both stamens and pistils; this is also the case in the greater number of the *Cinarocephalæ;* and the plants having this character were arranged by Linnæus into the order *Æqualis*, from the *equal* character of all the florets. This order also includes those of the *Corymbiferæ* which are destitute of *ray*. On the other hand, in the remainder of the Corymbiferæ, the florets of the disk only are perfect, possessing both stamens and pistils; and those of the ray seem to have the corolla developed at the expense of the stamens, which are absent; all the flowers however bear seed, those of the ray being fertilized by the pollen of those of the disk. This division was named by Linnæus *Superflua*, from the florets of the ray being as it were superfluous. Lastly, there are a few of the Cynarocephalæ in which the florets of the disk are perfect; whilst those around the margin are larger than the rest, so as in some instances to form a sort of ray (being still tubular, however,) and are entirely infertile. These are termed by Linnæus *Frustranea*, from their incomplete character.

632. It is chiefly among the Radiate group of this order, that those species exist which are valued as garden plants; and cultivation has frequently a remarkable effect on them. The corolla of the florets situated towards the margin of the disk undergoes an increased development, at the expense of the true reproductive organs; and they are changed into ligulate florets, deficient in stamens, and exactly resembling those of the ray. This change is particularly evident in the Dahlia, which has repaid the attention it has received, by a greater improvement in the aspect of its flowers, than any other species, perhaps, has exhibited. In its natural condition, it possessed, like most of its group, but a single row of ligulate florets; and all the centre of the flower was occupied, by the ordinary yellow disk. Under the influence of a rich soil however, the number of rows of ligulate florets has gradually increased: and these have also undergone great changes in regard to their size elegance of form, and beauty and variety of colour.

When a Dahlia is spoken of as eight, ten, or twelve-bloomed, it is meant that it has eight, ten, or twelve rows of ligulate florets. In its highest state of excellence as a garden flower, the florets of the disk nearly or altogether disappear; and the smaller the *eye* (as it is termed) of the Dahlia, the better it is considered to be. Such flowers, however, are not fertile,—that is, they do not produce ripe seed; for the conversion of the complete florets into those bearing pistils only, occasions a great deficiency of pollen. It is curious to observe the change which will be produced in the flower of a Dahlia, if a root of the best kind be planted in a poor soil. There will be an effort, so to speak, to produce a large number of ligulate florets; but these will be stunted and often curiously twisted; so that the flower is even less handsome and regular than that of a much poorer kind. The Dahlia is a native of Mexico, and in its wild state it is a bushy herbaceous plant, growing to the height of about seven or eight feet, with flowers by no means remarkable for their beauty. It was introduced into this country soon after the commencement of the present century.

633. The foregoing general account of the structure of this remarkable order, is all that the limits of the present Treatise permit to be given; a few remarks will now be added on its geographical distribution, its properties, and uses. The order attains its greatest development, in regard to the *size* of the species it contains, in the neighbourhood of the Equator; for whilst, in the temperate parts of the world, Compositæ are entirely herbaceous plants, those of Chili are bushes, and those of St. Helena are trees,—almost the only ones native to the island. But in regard to *number*, it would seem that they predominate rather in temperate regions, especially of the northern hemisphere, where they are considered as forming about one-sixth of the whole vegetation. In Britain, about 140 species of them may be reckoned, constituting about one-tenth of the whole number of native flowering-plants. In France they are estimated at about one-seventh, and in Germany at one-eighth; whilst in Lapland they are only one-fifteenth. In Sicily they are said to constitute more than half; and nearly the same proportion is found in some parts

f North America. In the north of New Holland, on the other and, the proportion is not more than one-sixteenth; and of a ollection of plants formed upon the western coast of Africa, it id not exceed one-twenty-third. The Cichoraceæ have been asertained to be more abundant in cold regions, and the Corymbiferæ n hotter ones.

634. In considering the properties of the order, it will be ecessary to advert separately to each of its subdivisions. The *Cichoaceæ* as already stated, possess a milky juice, which is bitter and stringent, as well as narcotic. These properties are strongly manifested in the *Lactuca virosa* or strong-scented Lettuce; for he juice, when concentrated, has narcotic effects sufficiently powerful to enable it to be used for the purpose of procuring sleep, nstead of opium; and the cells or vessels in which it is contained, are so irritable at the time of flowering, that, if the surface be ouched, the juice is forced out at that point. By proper cultivaion, however, the injurious properties may be so far removed from several species of this group, such as the Lettuce, Endive, Succory, that their fleshy stalks and leaves become wholesome articles of food. The roots, also, have often a considerable tendency to become fleshy, and may be generally eaten without danger. Those of the Succory are much used on the Continent, when roasted, as a substitute for Coffee; and they are very commonly mixed with it, being considered by many persons to improve its flavour. The roots of the Scorzonera and Tragopogon are known under the name of Salsafy, and are cultivated for the table in some places to a great extent; they are said to resemble those of Carrots and Parsnips in flavour. The roots of the Dandelion are used in Germany for the same purpose as those of the Succory; but in this country they are more employed for medicinal purposes, the extract prepared from them being considered by many as a useful tonic, promoting also the various secretions. In common with many other plants of this tribe, its leaves and stems are believed to be an excellent food for cows, promoting the secretion of milk to a great degree.

635. In the *Cinarocephalæ*, bitterness predominates; and the

principle to which it is due is generally mixed with gum, which is sometimes yielded by the plants of this group in great abundance. This bitterness is not found, however, in the unexpanded leaves, or in the receptacles of the flower-buds; on which account they may in many cases be used as wholesome articles of food. This is the case with the Cardoon, the Artichoke, and several other species. The roots, also, of many species are edible. The flowers of several species yield a yellow dye, which is most powerful in the *Carthamus tinctorius*; this plant is supplied from the Levant, and is often used to adulterate Saffron, as well as to tinge silk and cotton goods.

636. In the *Corymbiferæ*, the bitterness common to all the Compositæ, is combined with a resinous principle of stimulating character, which exists, however, in very different proportions in the various species. Few supply articles of food; almost the only species of which any part is eaten being a species of Sun-flower, of which the root is known under the name of the Jerusalem Artichoke. The former part of the name is a corruption of the Italian *Girasole*, which means "turning towards the sun." The seeds of the common Sun-flower are a nutritious food for poultry, and they are made into cakes by the North American Indians; a large quantity of a fixed oil may be extracted from them (§ 371). The roots of the Dahlia are fleshy, but their taste is very disagreeable. Of the medicinal properties of this group, those of the common Chamomile, which is in repute as a tonic and stomachic, are a good illustration; but there are many species in which the bitter, the resinous, or the astringent properties are more predominant, and which have, therefore, their respectively peculiar uses.

637. Quitting this extensive and important order, we next proceed to one which appears very different, but which has, nevertheless several points of affinity with it; this is the order CAMPANULACEÆ, or Harebell tribe, an extensive group, of which the species are scattered all over Europe, and in the cooler parts of Asia and America, dwelling in dells and dingles, by the banks of of rivers, in shady groves, and on the sides of mountains. The British species are humble plants, bedecked with no other orna-

ment than a few blue or purple nodding flowers; but in many foreign countries there are species of great brilliancy and richness of appearance, which are more striking from the barren nature of the situations in which they usually grow. The genus *Campanula* is so named from the *bell*-like from of its corolla; to which the latter part of its common English name—Hare-bell—also refers. Of this genus alone there are ten species in Britain, any one of which may be selected for examination. The calyx in this order consists of five adherent sepals, which enclose the ovarium, and then spread away from the top of it. The corolla has very much the figure of a bell, save that it is marked by five divisions at its edge, which show it to be made up of five petals; and it is veined in a very beautiful manner. From its base, and consequently from the summit of the ovary, there spring five stamens, whose filaments are broad and leaf-like at the base, and curve inwards, so as to press the long narrow anthers against the style, around which they cluster in the unblown flower almost as do the adherent anthers of the Compositæ; as soon as the flower unfolds, however, the anthers shrivel and fall back. The style is a taper stiff column longer than the stamens. It is covered all over, to the very tips of the stigma, with stiff hairs, which nature has provided to sweep the pollen out of the cells of the anthers, as the style passes through them in lengthening. If it were not for this simple but effectual contrivance, the pollen, which is set free by the bursting of the anthers as soon as the flower opens, would drop out of the nodding flowers, and be lost, before the stigma was expanded and ready to receive the fertilizing influence. The hairs of the style catch the pollen, and keep it until, by the agency of insects, by wind, or by other accidents, it is brushed down upon the inverted stigmas. Many

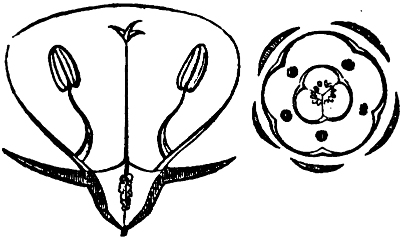


Fig. 99. Diagram of the flower of Campanulaceæ.

Cichoraceæ are also furnished with these collecting hairs, which thus constitute another point of alliance between the two groups; this alliance seems the strongest in some species of Campanulaceæ which have the flowers crowded together in heads.

638. On examining the ovarium of the Hare-bell, we find that it contains three cells surrounding a central axis; and that in each cell there is a large fleshy receptacle, to which a great number of minute ovules are attached. After these have been fertilized, and the rest of the flower has withered, the calyx still remains, enclosing the ovarium, and its sepals harden and enlarge; stout ribs appear in the ovarium; and the whole fruit, in ripening, becomes dry, brown, and hard. In most of the order, the capsule opens in the usual manner; but in the genus Campanula the mode is different. On looking at the top of the ovary between the sepals, —the point at which the separation of the carpels generally commences,—that part is found to be even tougher than the sides; but Nature has provided another very simple means for the exit of the fruit, by the rending of the ovarium (when every part of it becomes stretched so tight in drying, that some part of it must necessarily give way) at its sides, between the ribs, where the skin is weakest. The rent takes place in such a manner, as to leave a large orifice to each cell, through which the seeds are readily scattered.

639. A large proportion of the plants of the Hare-bell tribe are as harmless as they are beautiful; the roots of some species are eaten under the name of Rampion; the leaves of others are used in Salads; and the bells afford an abundant supply of honey to the Bee. The stem and roots abound in a milky juice (another character of alliance to the Cichoraceæ,) which does not possess any deleterious properties. There is a sub-division of the group, however, of which a separate order has been formed by some Botanists under the name of *Lobeliaceæ*, the Lobelia tribe, which is distinguished for its extreme acridity. The species belonging to it are known by the irregular form of their corolla, which has some resemblance to the ligulate florets of the Compositæ; and also by the partial cohesion of their anthers; so that they approach

the Compositæ still more decidedly than do the true Campanulaceæ. A character of much interest (which, however, can only be distinguished with the aid of the microscope) is, that in the true *Campanulaceæ* the pollen grains are *round*, whilst in the *Lobeliaceæ* they are oval. The plants of the latter group are most abundant in countries bordering on the tropics. Only one species is a native of England; but many more have been introduced into our gardens, where they are valued on account of the beauty of their flowers. One species, the *Lobelia inflata*, a native of North America has been used in medicine as an emetic and expectorant, and has been accounted a most important remedy for Asthma; it is very uncertain, however, in its effects, and has produced fatal consequences when given in an overdose.

640. The last order of Calycifloral Exogens which will be here noticed, is that of ERICINEÆ, the Heath tribe, a group of extreme beauty, which is easily recognized by certain peculiarities that distinguish it from all others. Of the common Heaths, the general aspect is known to every one; but there are many species far surpassing these in size, and differing so much in appearance, that they would not be associated with them by an unpractised Botanist. The true Heaths are most abundant at the Cape of Good Hope, where immense tracts are covered with them, and from which most of those exquisitely-beautiful species, which are cherished in our gardens and green-houses, are derived. Their corolla might be likened to that of Campanulaceæ; but the position of it is different; for both calyx and corolla are here beneath the ovarium, which is consequently *superior*. The calyx is usually small, and is cleft at the edge by four notches, which indicate that it is composed of that number of adherent sepals. The corolla is a tube, sometimes swelling out into a little globe, with four short teeth at

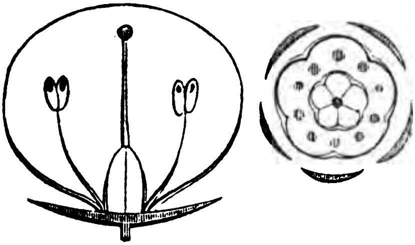


Fig. 100. Diagram of flower of Ericeæ.

the end, showing that this is composed of four petals, united up to their points. Arising from beneath the ovarium, and perfectly separate from the corolla, there are eight stamens, whose anthers are purple, and their two lobes separated towards their points like the prongs of a fork; the anther-lobes, instead of bursting in the usual manner, open by *pores* or minute apertures at their extremities,—a character which is peculiar to the Heath tribe, and marks every member of it. The ovary contains four cells, each including a great many ovules; it bears a single style, having a flat purple stigma, with four little projections upon it. This in time changes to a dry capsule that bursts by valves, scattering an immense multitude of seeds almost as minute as grains of sand; and these are frequently provided with little crests or fringes, which enable the wind to catch and disperse them, and are technically called wings.

641. The foregoing description applies especially to the true *Heaths;* there are many other species belonging to the order, which present several variations from it. For example, the calyx and corolla may be formed of three or five pieces, instead of four; the number of stamens may be equal to that of the petals, instead of double; and the number of cells in the ovary is variable. The essential characters of the order are the hypogynous stamens, and the opening of the anthers by pores. To this group belong the *Rhododendrons*, *Kalmias*, and *Azaleas*, which are now so abundant in our gardens; giving them cheerfulness, by their evergreen aspect, even in the depths of winter; and making them gay, with their beautiful blossoms, through the warmer parts of the year. The two former are natives of America; the latter comes from Asia Minor; but they are now all naturalized in this country, though liable to injury from the cold of winter, unless they are planted in sheltered situations. The Rhododendrons and Azaleas differ from the rest of the group in the irregularity of the corolla, which has unequal divisions and spreads open at the mouth; the stamens, too, are bent towards one side. The Kalmia is remarkable for the manner in which the stamens are held down by the corolla, until the pollen is ready to be shed; the filaments are

curved outwards, away from the pistil; and the anthers are lodged as it were in little niches in the corolla, by which they are held, until the complete expansion of the flower, or any cause (such as the contact of insects) which gives the filaments a slight movement, sets them free, and they rise up with a spring, scattering the pollen on the stigma.

642. To what has already been stated of the geographical distribution of this order, it may be added that it is not abundant in Asia, and that it is almost unknown in Australia, where, however, its place is supplied by another, which differs from it in little but the structure of the anther. The general quality of the group is astringency; and several species have been used in medicine. Many species have succulent berries for fruit, which may be used as food; this is the case with the Arbutus, sometimes called Strawberry tree, from the flavour and appearance of its berry, from which an agreeable wine is said to be prepared in Corsica. The Rhododendrons, Azaleas, and Kalmias, however, possess more active properties than the rest, and are decidedly poisonous to man. The honey which is made from their flowers has proved extremely deleterious to those who have eaten of it; and it has been said that the flesh of Birds that have fed on the buds of the Kalmia becomes alike injurious.

643. The following tabular arrangement of the chief British orders that have been described in this sub-class will assist the student in distinguishing them.

Sub-class II. COROLLIFLORÆ.

Sepals of calyx adherent into a cup or tube. Calyx united to the disk. Petals and stamens apparently springing from the calyx.

- A. Petals of corolla distinct, or nearly so.
  - *a*, Carpels distinct, or but slightly adherent, each having its style and stigma.

a, With stipules.		
Carpels numerous	*Rosaceæ*,	593
Carpels solitary	*Leguminosæ*,	586
β, Without stipules.		
Vegetation succulent ..	*Crassulaceæ*,	609
Vegetation not succulent ..	*Saxifrageæ*,	615
b, Carpels completely united.		
a, Ovary superior.		
Stamens opposite the petals	*Rhamneæ*,	583
Stamens alternate with the petals,	*Celastrineæ*,	582
β, Ovary inferior.		
Ovary 1-celled	*Grossulariæ*,	613
Ovary 2-celled	*Umbelliferæ*,	617
Ovary 4-celled	*Onagrariaceæ*,	599
B.* Petals cohering into a tube, to a greater or less extent.		
a, Ovary inferior.		
a, Ovary 1-celled.		
Seeds numerous, placentæ parietal	*Cucurbitaceæ*,	606
Seeds single	*Compositæ*,	629
β, Ovary 2 or more-celled.		
Leaves opposite.		
With stipules	*Caprifoliaceæ*,	62
Without stipules ..	*Rubiaceæ*,	624
Leaves alternate	*Campanulaceæ*,	637
b, Ovary superior	*Ericineæ*,	640

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* This division, with the exception of Cucurbitaceæ, is placed by many Botanists who adopt De Candolle's system, in the next class. With the exception of the last order, Ericineæ, which is easily distinguished from all others, by the mode of opening of its anthers, they are at once known from the Monopetalous orders of the next sub-class by their inferior ovarium.

SUB-CLASS III. COROLLIFLORÆ.

644. The members of this division are easily distinguished from the foregoing, by attention to the following particulars. The calyx and corolla are each formed in one piece,—that is, the sepals and petals are adherent at their edges; but they are quite distinct from each other, and from the ovarium, which is consequently always superior (save in a few exceptions). The stamens are adherent to the base of the corolla, and, as it were, inserted into it. The only one of the foregoing orders to which these characters apply, is the Heath tribe, which connects the preceding sub-class with this one, serving as an illustration of the general principle formerly mentioned,—that, in any Natural arrangement, such links must occur, the true place of which may be doubtful.

645. The first order in this sub-class, although of small importance, may yet be briefly noticed, because every one is familiar with some species of it, which will serve as an illustration of the general structure of the group. This is the order PRIMULACEÆ, or *Primrose* tribe, the flowers of which are easily described. The Calyx is formed of one piece, cleft into 4 or 5 teeth, however, at the edges, indicating that it is composed of 4 or 5 adherent sepals; and a division of the same sort presents itself in the corolla, which has generally a rather long tube. On drawing away the latter, in the common Primrose, Cowslip, or Polyanthus, the stamens will come away with it; and on counting them, it will be found that they are equal in number to the divisions of the corolla, but are *opposite* to it, indicating that there is a whorl deficient. This whorl is distinguishable in the genus *Samolus*, or Water Pimpernel (§ 465). The ovarium consists of but one cell, the placenta being central, and the partitions not being developed; it contains a large number of ovules. The style and stigma are single.

646. The great uniformity of these characters occasions the largest part of the order to be included in the Linnæan class and order PENTANDRIA *Monogynia;* and here we meet with several genera well known in Britain. Besides the Primrose, Cowslip,

Oxlip, and Polyanthus,—which may all grow from the same root, or be raised from the seeds of the same flower, thus showing that they are altered forms of the same species,—there is the *Anagallis* or Pimpernel, commonly termed the Poor-man's weather-glass, from its property of closing on the approach of a storm,—the Lysimachia, or Loose-strife, inhabiting moist places,—and the *Cyclamen*, or Sow-bread, so named because its tuberous roots notwithstanding their very acrid character, are eagerly devoured by swine. This last plant is abundant in Sicily, and is the chief food of the wild-boars of the island. The group is extensively diffused over the globe, but is more abundant in northern and in mountainous countries; it is only cultivated for ornament, as it does not possess any properties which make it otherwise useful to man. It is interesting to remark that the genus Samolus, having the perianth adherent to the ovary, which is consequently *inferior*, is an aberrant form (§ 503) of the order, which leads us back into the preceding group. The difference is considered one of such importance, that, if it were presented by a greater number of Plants (of the Samolus only two species are known) they would be formed into a separate order.

647. The next order to be mentioned is one of more direct utility to man; this is the order OLEACEÆ or *Olive* tribe, of which many species inhabit England, although it is found most abundantly in the South of Europe. Instead of being humble and insignificant plants, the members of this order are always either trees or shrubs, and sometimes attain considerable size and beauty; such are the Ash and the Lilac. One of the most common of the British species is the Privet, the fructification of which may be taken as an illustration of that of the order. The calyx is a four-toothed cup; and the corolla is formed of the same number of petals, adherent at their lower part into a tube, within which are two stamens. The existence of only two stamens within a regular monopetalous corolla is a character which is nearly peculiar to this order, being shared with it only by the Jasmine tribe. The ovary contains two cells; and from the top of each hang down two ovules. The style is single, and is terminated by a two-lobed

stigma. The ovary changes in ripening into a small round succulent fruit or berry, containing but one seed, the others not having been developed. These are the general characters of the Olive tribe; but there are some remarkable exceptions. The Ash, for example, is placed in this tribe, although it is destitute of corolla; and although this character would, if taken alone, cause a place to be assigned to it in the next sub-class, rather than in this, yet when it is remembered that the *natural* system is founded, not upon one or two characters only, but upon *general* conformity, it will be seen that the proper place of the Ash is in this order, since it agrees with the Olive in every important particular, except the absence of the corolla. A curious circumstance, which unequivocally proves their near relationship, is that the Ash and the Olive will graft very well together

648. The most important species of this order is undoubtedly the Olive, the extensive cultivation of which in warm countries, on account of the oil yielded by its fruit, has been already noticed. The wood of the Olive is beautifully veined and takes a high polish; and having also an agreeable smell, it is much esteemed for ornamental work. The Ash is one of the most valuable of trees, both on account of the number of useful purposes to which its wood is applied, and because it agrees with a greater variety of soil and situation than any other tree producing equally good timber. It differs too, from most other trees in this,—that its value is increased rather than diminished by the rapidity of its growth. The wood of the Ash is chiefly distinguished by its elasticity; so that, although much less tough than that of the Oak, and more easily split, it is not so readily broken by a cross strain. It is therefore of great use for agricultural and other implements, nothing being equal to it for poles, ladders, long handles, and other purposes, in which strength and elasticity are required in combination with lightness. The Ash seldom attains any great size as a forest tree; and it is not of consequence that it should, as the wood of moderately-old trees is the most serviceable. It is one of the most elegant, however, of forest-trees; being peculiarly distinguished by its lightness and gracefulness of aspect.

Allied to the Ash, but possessing a corolla, is the Manna-ash, which (in common with other species) yields that peculiar exudation, consisting of sugar mixed up with a purgative principle, known in medicine under the name of Manna. This is brought to England chiefly from the South of Italy; and it is principally employed as an aperient for children, who are attracted by its sweet taste. The leaves of the common Ash are said to have similar properties; and its bark, which is bitter, has been substituted for Cinchona bark in fevers. A remarkable fact respecting the Ash, which seems to show that the secretions of its leaves are injurious to other plants, is, that its *drip*,—that is, the rain that drops from its branches,—renders the ground unproductive around it.

649. Nearly allied to the Olive tribe is the small order JASMINEÆ or *Jessamine* tribe, a group of elegant and fragrant trailing shrubs, which differs but little from the preceding order. The divisions of the corolla are five instead of four; and the petals are imbricated, or fold over each other, before expanding, instead of having their edges in contact as in Oleaceæ. Moreover, the seeds rise up from the bottom of the ovarium, instead of hanging down from its summit. The Jasmines are most abundant, and attain their greatest fragrancy, in tropical climates; the species which is cultivated in this country is not a native of Britain, but is imported from the south of Europe.

650. The Order to be next adverted to is that of GENTIANEÆ, the *Gentian* tribe, which is distinguished by the vividness of the colours of its flowers, and the extreme neatness of the aspect of the foliage. This tribe may be known from all other Monopetalous Exogens, by the structure of its leaves, which are opposite each other on the stem, and have two, four, or more strong veins, parallel with the midrib. The Gentians have a regular corolla, formed, like the calyx, by the partial union of five divisions; it has somewhat of the *plaited* appearance, which is observed in the Convolvulaceæ. The stamens are four or five in number; the ovary is two-celled, with a large number of seeds in each; the style is single, but the stigma is two-lobed. The fruit ripens into

a dry capsule with two valves. The tribe is not a very extensive one; and the principal part of it is met with in South America. There are some hardy species, which abound over the milder and more elevated districts of Southern Europe and Asia; covering the sides of hills with blossoms of such intense brilliancy, that the eye can scarcely rest upon them. Several genera of this order are common in Britain; the chief are the Gentian, and the Centaury. The whole order is characterized by the presence of a very bitter principle, which exists in the leaves, flowers, bark and roots; this is much valued in medicine as a tonic.

651. Another well-known order, chiefly important on account of the valuable medicinal products which it yields, is that of CONVOLVULACEÆ, the *Convolvulus* or *Bindweed* tribe. The species with which we are familiar in this country are for the most part trailing plants, depending for support upon others; but between the tropics, where the order especially abounds, we find it containing also standard shrubs and even trees. The calyx and corolla in this order each consist of five divisions; the sepals usually overlie each other so completely, however, that only the two outer ones can be distinguished. Very commonly the petals are so completely adherent, that they do not separate even at their extremities; this we notice in the common Bindweed of our hedges. This order is remarkable for the curious *plaiting* into which the corolla folds when it closes. In most species it opens and closes under the influence either of light or of darkness,—some opening only in the day, and others only at night; and there is one curious species, in which the flowers are so sensitive as to contract beneath the touch, like the leaves of the Sensitive plant. The stamens are five in number, and are opposite to the sepals of the calyx. The ovarium usually contains three or four cells, in each of which there are but one or two ovules; the style is single, but divides into two long stigmas. The fruit is a capsule, opening by valves equal in number to the divisions of the ovarium. The form of the embryo is curious, and serves to distinguish this order from others that are nearly allied to it in the preceding characters; it is doubled up in a remarkable manner, as if there were not

room within the seed for it to grow; and the cotyledons are small and shrivelled, being occasionally altogether absent. The greater number of species may also be distinguished from other monopetalous plants, by their milky juices; but this character is less apparent in the annual species of temperate climates, which seem as if they had not time to elaborate them, than in those which increase from year to year, and form woody roots and stems.

652. It is among these last, that the peculiar characters of the order chiefly manifest themselves. They form an acrid resinous matter, possessing active purgative properties. This is especially abundant in the roots and rhizomas; and is obtained from several species for medicinal purposes. The resinous extract known as *Scammony* is the milky juice, obtained from a species that grows in the countries bordering on the Levant, and hardened by exposure to the air. The high price of this drug partly depends upon the heavy duty to which it is subjected; and it is one extremely liable to adulteration. The drug known as *Jalap* is the powdered root of an American species, from which also a resinous extract might be obtained; but the active principle exists so largely in the roots, that there is no necessity for thus concentrating it. When administered in proper doses, it is a safe as well as active medicine; it is also a very cheap one; and a very large quantity of it is accordingly consumed in this country,—between 2 and 300,000 ℔s being annually imported, chiefly from Vera Cruz. The common Bindweed of this country has similar properties in a less degree. There are some species of Convolvulus, however, which form a large fleshy root; and the resin contained in this exists in such small proportion to the starch, that it forms a harmless and nutritious article of food. These roots are known in tropical countries (in some of which they are much employed) under the name of *Sweet Potatoes*. The leaves and young shoots of these may also be eaten as pot-herbs.

653. This order includes a curious parasitic group, that of the various species of *Cuscuta* or Dodder, whose general habits have been already described (§ 344). The Dodder may be frequently

seen on the stems of Heath, Furze, or Nettles, in the form of a cluster of stout reddish cords, which are so entwined together, that they might be almost taken for a knot of young snakes. The only vestiges of leaves consist of a few stunted scales; and it is curious that the cotyledons also are nearly undiscoverable,—a character that shows the alliance of this group to the Convolvulus tribe, with which it is said also to agree, in the possession of purgative properties.

654. The next order we shall notice is also a large one, chiefly consisting, however, of humble plants; but these attract attention from their aromatic character, which occasions many of them to be cultivated by man for various purposes, and also from their great abundance, especially in the northern temperate regions. The order now alluded to is that of LABIATÆ, or Labiate plants, so named from the peculiar form of the corolla, which seems to have a pair of *lips;* we may designate it as the *Mint* tribe, from some of its best-known species. In all the preceding orders of this sub-class, both calyx and corolla have been *regular;* that is, their parts are equal, or nearly so. In the Labiatæ, however, this is not the case. The calyx is a little cup, with five teeth at its edge, which are sometimes equal; but in general it is divided by a deeper cleft, into two unequal lips, of which one has three teeth and the other two. The corolla is tubular at the base, but is divided above into two unequal lips, of which the upper one is narrow and concave, whilst the lower one is broad and convex; the upper consists of two adherent petals, and the lower one of three, of which the central one is usually the broadest. There can be no difficulty in recognizing a *labiate* corolla from this description; but the plants belonging to the order may be even more readily distinguished by their stamens. These are four in number, lying within the tube of the corolla; and two are longer than the rest; so that their character is, in the Linnæan language, *Didynamous*, and the whole group corresponds with the first order of the Linnæan class DIDYNAMIA. In some instances, however, only two stamens are present. The anthers are peculiar in the great separation of the lobes, which touch each other only

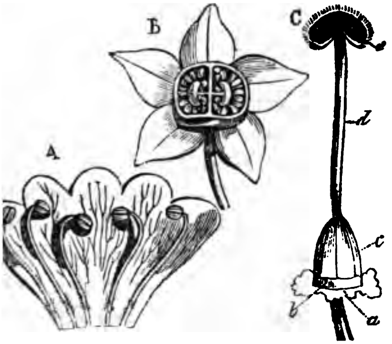
at their points; in the Sage, only a single lobe is developed (§ 432). The ovarium externally presents four divisions, from which it might be supposed to consist of four carpels; in reality, however, there are only two cells, each of which contains two ovules; and these four seeds, being large, give the form to the seed-vessel which encloses them. The style is single, but cleft at the top, where it carries two stigmas. When the fruit ripens, the seed-vessel splits into four portions, each closely enveloping a seed, so as to form a sort of grain or nut like that of the Ranunculaceæ or Umbelliferæ; and the four are concealed in the bottom ot the calyx, which does not fall off with the rest of the flowers. As the seeds, in consequence of the close adhesion to them of the walls of the carpel, do not seem to have a distinct envelope, they are frequently said (though erroneously) to be *naked;* and hence this group is placed in the Linnæan order *Gymnospermia*, with which it exactly corresponds. In the structure of the ovarium, the Labiatæ much resemble the *Borage* tribe, an order to which belong several British plants of great beauty, such as the Forget-me-not, the Viper's Bugloss, &c; but the former are readily known by their square stems, opposite leaves, irregular corolla, and aromatic properties.

655. The Labiatæ principally inhabit dry situations in temperate climates; they constitute about one-twenty-fifth of the Flowering Plants of France and Germany; and diminish in their proportional number as we pass towards warmer or colder climes. None of them are poisonous or even injurious; but their strongly aromatic character prevents them from being used as staple articles of food, though many of them, such as the Mints, Sage, Thyme, Rosemary, Balm, &c. are employed to give flavour to various dishes, or are valued for their medicinal properties. The aromatic principle is an essential oil, which is found in numerous receptacles in the leaves and stalks, and which contains a large quantity of camphor.

656. The next order is also an extensive one, and it is of much greater direct importance to man, supplying him with one of his staple articles of food, and with some of his most valuable

dicines, as well as with other products in most extensive use; d all this, whilst one of the most poisonous tribes in the whole vegetable kingdom. This is the order SOLANEÆ, or *Nightshade* tribe, of which the common Deadly Nightshade will serve as a characteristic example. We here return to flowers whose structure is regular or nearly so. The calyx presents five equal teeth; the monopetalous carolla has five equal divisions; there are five equal stamens; and the ovarium has two cells, in each of which is a number of ovules. In all these characters, there is nothing to mark the distinction of this order from the Gentianeæ, in which the structure of the flower is almost exactly similar. In the Linnæan classification, however, they are distinguished by this,—that the style is altogether single in the Solaneæ, so that the genera belonging to it are placed in the order *Monogynia* of the class PENTANDRIA, whilst many of those of

ig. 101. Branch of *Atropa Belladonna*, or Deadly htshade, with buds, flowers, and fruit.



ig. 102. Parts of flower of the same. A, olla cut open, showing the stamens inserted on B, calyx, with ovarium cut across. C, pistil, h *a*, origin of calyx, *b*, origin of corolla, *c*, ovan, *d*, style, and *e*, stigma.

the order Gentianeæ, in which the style is cleft at the top, belong to the order *Digynia* of the same class. A more important and constant distinction, however, may be drawn from the arrangement of the leaves, which are *opposite* in the Gentian tribe, and *alternate* in the Nightshade tribe. It is well, on account of the poisonous properties of this tribe, to remember its distinguishing characters; and the following definition comprehends all that is necessary to distinguish this order from every other;—the flower is monopetalous and regular, the ovary superior with two cells; and the leaves alternate. The fruit consists of a capsule, which is very commonly swollen into a fleshy berry.

657. The native British plants contained in this order are the Bitter-sweet, whose red and tempting berries are a dangerous decoy to children, the Deadly Nightshade, Henbane, and Thorn-Apple. They are all distinguished by their narcotic properties, which render them serviceable in medicine when skilfully administered; but they have also a considerable degree of acridity, and often operate as violent irritants, when taken in an overdose or accidently eaten. The order is widely spread over the globe, however; and some species of it are found in almost all countries except the polar regions. A large proportion are natives of tropical countries; and among these are several which are most employed by man. The first to be mentioned, because the one in most general use, is the *Nicotiana*, the leaves of several species of which constitute Tobacco; this was used in Persia, in which country it grows, long before the discovery of America; but it is from that continent, and from the West Indian islands, that Europe now derives its chief supply. Two species only are in sufficient repute to make their cultivation desirable; and these must be very extensively grown, to supply the enormous demand that now exists for what was once considered a noxious weed. The practice of smoking tobacco was introduced into England by Sir Walter Raleigh, and the settlers who returned from Virginia, about the year 1586. The use of tobacco, like that of coffee, encountered much opposition. Laws were made against its importation, and severe penalties were ordered against the employ-

ment of it. Book after book was written to deter the public from its use; but, as in the case of other forbidden gratifications, the more attempts were made to prevent it, the greater was the use made of it. Even King James I. of England wrote a book against it, bearing the name of the "Counterblaste." In this, the habit of smoking is execrated as barbarous, being derived from savages, and as in itself filthy; and the Royal Author not only condemned it as injurious to the health, but as absolutely poisonous. He gives the following ridiculous account of the appearances found in the bodies of inveterate smokers, as sober truth. "Surely smoke becomes a kitchen farre better than a dining chamber; and yet it makes a kitchen oftentimes in the inward parts of men, soyling and infecting them with an unctuous and oyly kind of soote, as hath been found in some great tobacco-takers, that after death were opened." He concludes with styling it "a custom loathsome to the eye, hateful to the nose, harmfull to the braine, dangerous to the lungs, and in the black stinking fume thereof nearest resembling the horrible Stygian smoke of the pit that is bottomless." Notwithstanding such opposition, smoking, together with the use of snuff, has spread not only through civilized but among savage nations; and there is now probably no single product of the vegetable kingdom which is so extensively employed.

658. That excessive smoking is injurious, like excessive indulgence of any other kind, there can be no doubt; that the more moderate practice of it injures the health of many persons, who would be very unwilling to give it up, is equally certain; but, in regard to the deleterious effects of the use of it, there is less to be said than against the habitual employment of fermented liquors; and the discontinuance of the practice might be rather urged on the ground of cleanliness and economy, than upon such arguments. We quite agree with King James that "smoke becomes a kitchen"; and in regard to snuff-taking we are of the opinion of the barrister, who is said to have thus replied to a friend who offered him a pinch,—"Sir, if the Almighty had intended my nostrils for a dust-hole, he would not have turned them upside-down." We would seriously urge, upon our younger readers especially, the

desirableness of not being drawn by example or ridicule, into a custom which has nothing really to recommend it, and which will often prevent them, by the expense and time it involves, from doing what they might for the improvement of their minds. Some idea of the amount of money expended upon this indulgence may be formed from the fact, that about 25 million pounds are annually imported for use in this country, of which the duty alone is about three millions and a half sterling; and as the duty is extremely high in proportion to its value (being 3*s* per pound for all kinds, whilst the cost of the inferior sorts is but about 2½*d*, and of the best 6*d*, before paying it), smuggling is carried on to a greater extent than in almost any other article. It has been reckoned that one-fourth of the tobacco consumed in Great Britain, and three-fourths of that used in Ireland, is smuggled.

659. In striking contrast with the Tobacco-plant, we have now to speak of another species of this order, the ***Potatoe***, which might be thought to bely what has been said of the general properties of the group; this apparent exception to the general rule has been already explained (§ 479). It is well known that the leaves, stems, and fruit, contain the narcotic principle, though in a less degree than those of many other species; and the juice which may be pressed from the uncooked potatoe itself is also unwholesome. Although the cultivated varieties of this plant are now so numerous, it is difficult to discover it with certainty in the wild state. It was first brought into Europe by the Spaniards, from the neighbourhood of Quito, in the early part of the 16th century; but it was not introduced into England until 1586, when it was brought by Sir Walter Raleigh from Virginia. It is said that he distributed a number of tubers in Ireland, where they were planted and throve exceedingly well; and that they were subsequently introduced into England from the Sister island. It is a remarkable fact in the history of this plant, that the colony of Virginia was some years afterwards saved from famine, by a large supply conveyed across the Atlantic from the very country, to which they had so short a time before been sent. The Potatoe

was not brought into general cultivation in this country, until the beginning of the eighteenth century; and it was near the close of it, before much attention was paid to the varieties of this plant, or before it was planted over a large extent of ground. It has this great advantage over most other vegetables which are standard articles of food;—that it can not only be cultivated in places where no others can be profitably grown, but that it can be cultivated there at a small expense, and is less likely to be affected by unfavourable states of the weather, than are most other crops.

660. The last order of this group which will be here noticed, is that of SCROPHULARINEÆ, which may be explained as the *Foxglove* or *Snapdragon* tribe,—these being two of the species best known, and at the same time most characteristic of it. This order is remarkable, like the Labiatæ, for the irregularity in the form of its flowers, which is even carried (in many species) much further than it ever is in that group; but it is strikingly different from it in properties; for instead of being harmless and agreeable to the taste, many of the plants belonging to it are, like the Solaneæ, virulent poisons, having strong acrid and narcotic properties, and all are suspicious. Instead of being, however, like a great part of the Solaneæ, of a dark and lurid aspect, which might almost lead us to suspect their injurious character, the plants of the Foxglove tribe are for the most part handsome, often possessing very brilliantly-coloured flowers. This order could not be readily distinguished from the Labiatæ by anything in the structure of its calyx, corolla, or stamens, which last are (as in the Labiatæ) *didynamous;* but they are at once known by the structure of the seed-vessel, which does not present externally a division into four lobes, but only into two; each of the two cells encloses a large number of ovules, instead of containing only two; and in ripening, the seed-vessel forms a distinct capsule with two valves. By this last character alone, this group is separated from the Labiatæ in the Linnæan arrangement, being placed in the second order, *Angiospermia*, the name of which refers to the enclosure of the seeds in a capsule, contrasted with their supposed nakedness in the preceding one. This Linnæan order also includes the

OROBANCHEÆ, or *Broom-rape* tribe, which is nearly allied to the Scrophularineæ, differing from it chiefly in the absence of leaves, and in its parasitic habits, which resemble those of the Dodder.

661. The common *Foxglove* (Digitalis purpurea) is one of the most handsome of the native British species of Scrophularineæ. Its corolla somewhat resembles the finger of a glove (whence its name is derived) and is of a crimson hue, its throat or entrance being spotted with rich purple; its border is divided obliquely into five very short segments, of which the two upper are the smaller. In the *Snap-dragon*, the lower lip projects inwards in such a manner as to press against the upper, so that the entrance to the tube is quite closed; on pressing the flower sideways, however, the two lips separate, as if the mouth were opening. In the *Calceolaria*, or slipper-shaped flower, of which an immense number of varieties are now in cultivation in this country (§ 454), the lower lip is blown out (as it were) into the likeness of a clumsy slipper. In the *Scrophularia* (Figwort), on the other hand, the corolla is globular, with a very large upper and small under lip. It is curious to observe the tendency to a return to the regular form, which some of these plants occasionally exhibit. Thus, a monstrous form of the Snapdragon is not uncommon, in which the flower is circular, every petal having the same form, and each having the spur or downward prolongation which is usually possessed by one alone; and five stamens of equal length being developed. An exception to the general character of the order, is presented by the common Speedwell, in which there are only two stamens; and also by many foreign species.

662. The plants of this order are found abundantly in all parts of the world, from the coldest regions in which the vegetation of Flowering-plants takes place, to the hottest places within the tropics. One species is found in Melville Island, which seems too cold a situation for the Labiatæ; and several ornament the sterile shores of Terra del Fuego. They are mostly acrid and bitter; and the leaves and roots of many species act as purgatives and even emetics. These qualities are united in the Foxglove (which approaches in many of its character to the Solaneæ)

with a remarkable power of depressing the nervous system, and of diminishing the action of the heart; and, when cautiously administered, this is a medicine of great value.

663. The following table will enable the student to distinguish such of the orders of this sub-class, as he is likely to meet with among British Plants. Here, as elsewhere, it is to be remarked, that such tabular arrangements, being founded upon such *single* characters only as are easily recognized, do not at all represent the real affinities or relationships between the orders.

Sub-class III. Corollifloræ.

Monopetalous Exogens, having a superior ovary, and the stamens inserted on the corolla.

A. Flowers regular, stamens of equal length.		
a, Ovary 4-lobed externally ..	*Boragineæ*,	654
b, Ovary undivided.		
α, Carpels 4 or 5.		
Stamens opposite petals,	*Primulaceæ*,	645
Stamens alternating with petals,	*Convolvulaceæ*,	651
β, Carpels only 2		
Stamens 2	*Oleaceæ*,	647
Stamens 4 or more.		
Calyx imbricated ..	*Convolvulaceæ* *	
Calyx in a perfect whorl.		
Leaves opposite ..	*Gentianeæ*,	650
Leaves alternate ..	*Solaneæ*,	656
B. Flowers irregular, stamens usually tetradynamous.		
a, Ovary 4-lobed externally ..	*Labiatæ*,	654
b, Ovary undivided, a two-celled capsule.		
α, Stems leafy, not parasitic ..	*Scrophularineæ*,	660
β, Stems leafless, habits parasitic.	*Orobancheæ*,	660

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* This order is repeated here, because several of its species, as the Dodders, have less than four carpels developed in the ovary.

SUB-CLASS IV. MONOCHLAMYDEÆ.

664. In this sub-class, the perianth never consists of more than a single whorl, which may be considered in the light of a calyx or of a corolla. In many instances there is no vestige of either one or the other, and the fructification is reduced to its simplest possible condition. It is interesting to remark that, although this group does not contain nearly so many species distinguished for their peculiar properties, as do the former ones, yet it includes a large proportion of those whose stems furnish us with valuable timber, —for example, the Oak, Elm, and Fir tribes; so that it would seem, as if the suppression of some of the organs of fructification, by which the race is multiplied, were favourable to the development of the individual structure. The first two orders to be noticed are of no great importance in themselves; but, as they contain several British species, it is desirable not to pass them by.

665. The order CHENOPODEÆ, or *Goosefoot* tribe, has a perianth composed of five adherent portions, in the base of which, and opposite to the segments, are inserted five stamens. The ovarium is superior and one-celled; it contains but a single ovule, which is attached to the base of the cavity. The style may be single, or several may be present. The plants of this order inhabit waste places in all parts of the world, abounding mostly in the northern parts of Europe and Asia; they are mostly considered rank weeds; but some of them have been rendered by cultivation very serviceable to man. The common *Goosefoot*, which may be considered as a type of the order, is so named from the peculiar form of the leaves. Some foreign species of it are used medicinally in the countries where they grow. The most important products of this order, however, are not of a medicinal, but of a nutritious character. Of several species, such as Spinage, the leaves and stems are used as potherbs; of others, such as Beet, the root becomes very fleshy under cultivation, and affords a large quantity of wholesome aliment. One species of Beet is cultivated in England under the name of *mangel wurzel*, or root of scarcity, to furnish winter food for cattle; it is often a very profitable crop, the

roots growing to the weight of 20, 30, or even 60 ℔s; and it does not exhaust the soil. Another species or variety of Beet is extensively cultivated in France, on account of the sugar which it yields; this product is not so good as that made from the cane, nor can it be raised so cheaply; nevertheless the nation is obliged to employ it, on account of the heavy duty which is placed upon the sugar of the West Indies, Brazil, &c. Another plant, which was at one time of much importance, is the *Salsola soda*, which, when grown near the sea shore, contains a large quantity of the alkali Soda; and this was obtained from it by burning. Soda is now more abundantly procured, however, by other processes. Another British genus, the *Salicornia* or Glasswort, was of similar utility; this is remarkable for having but a single stamen. The genus *Atriplex*, or Orache, deserves mention on account of its being *polygamous*, that is, bearing complete, as well as incomplete flowers on the same plant. The complete and stamineous flowers have a 5-parted calyx; whilst the calyx of the pistilline flowers is formed of two valves only.

666. The next order to be mentioned is that of Polygoneæ, or the *Buck-wheat* tribe, which, like the last, contains many of the most common weeds that overrun waste places in every latitude, together with several important plants. The characters of this order are easily recognized. The perianth is composed of from 3 to 6 pieces, adherent at the base, and folded over each other,—sometimes to such a degree as to give the appearance of a double whorl. The stamens are usually few in number, and are inserted in the bottom of the calyx. The ovarium is superior, with a single erect ovule in its cavity; and has either several styles, or a single style with many stigmas. In these respects, the Polygoneæ do not present any marked difference from the Chenopodeæ; but they may be distinguished by this important character,—that, whilst the latter are destitute of stipules, the former have them very large, and cohering round the stem so as to enclose the leaf-buds, before they expand, in the manner of a boot; this is well seen in the common garden Rhubarb. The seed usually contains a considerable quantity of mealy albumen, which is increased by

cultivation to such a degree, as to make it in some species worth raising, especially as these plants will usually grow on the poorest soils. The juices of these plants, however, are astringent and sometimes purgative, occasionally also possessing acidity. But in general these properties are diffused in no large amount through their substance; so as not to be easily available. The chief medicinal product afforded by this order, is Rhubarb, which is the root or rhizoma of one or more species of *Rheum*, and is best obtained from warm countries, though it has been produced in Britain. The garden Rhubarb of this country corresponds with the common Sorrel and Dock, which also belong to this order, in the acidity of its leaves and leaf-stalks, on account of which it is cultivated. The *Polygonum bistorta*, or Bistort, so named on account of the twice-twisted form of its roots, is one of the most powerful of vegetable astringents; and the roots abound in starchy matter, which, when the tan has been separated, may be used as food. The *Polygonum fagopyrum*, or Buck-wheat, should more properly be called Beech-wheat; since it derives both its scientific and its common name from the resemblance between its seeds and beech-mast. In China and many parts of the East, it has long been cultivated as a bread-corn, and it was introduced into Europe by the Crusaders; it is not grown to nearly the same extent in this country as on the Continent.

667. The next order, LAURINEÆ, or *Laurel* tribe, is almost entirely confined to tropical climates; and is chiefly interesting on account of the number of valuable products which it yields. The Common Bay is the most northern species; and this does not naturally grow in countries more temperate than those of the south of Europe. The order is easily known from those allied to it, by the mode of bursting of the anthers, which open by valves in the same manner as the Berberry (Fig. 46, § 432). The perianth consists of 6 portions, arranged in an imbricated manner; at the base of these are attached the stamens, which are either 6 or 12 in number. The ovarium is one-celled, containing a single pendulous ovule; and it is surmounted by a single style. This order contains, with many shrubby species, some which rank as

large trees; one genus, however, differs from the rest in being leafless and parasitic; and it is remarkable that this is the only plant of the order which is a native of Africa. The Bay laurel was formerly in repute as a medicine; but it seems to have been yet more esteemed among the ancients, since wreaths formed of it were awarded as victorious crowns, to those who had distinguished themselves by their courage in war, or by their superiority in learning. It is curious that the present university degree of *Bachelor* (of Medicine, Arts, &c.) should take its origin in this circumstance; the term Bachelor, is merely a corruption of the word Baccalaureate, which means laurel-berried; the latter part of the word being also the distinction of the Poet who is appointed to make verses, on stated occasions, in honour of the sovereigns of Britain. The Laurineæ are all aromatic plants, containing in their leaves, bark, &c., a powerful essential oil, which gives them a strong and pleasant odour, and a warm and pleasant taste. The most valuable products of this order are Cinnamon and Camphor. The former is the bark of the younger twigs of several species of Laurel, which grow best in the islands of the Asiatic Archipelago. Cassia bark is inferior to Cinnamon in strength of flavour, but is often passed off for it. Sassafras is another aromatic product of this order; it is brought from South America. Camphor may be obtained from nearly every species of the tribe in greater or less proportion; but it is now found to be more abundantly yielded by trees of other kinds. The Alligator-pear of the West Indies (the first name of which is a corruption of the original name Avocado) is the fruit of a species of Laurel; it is much esteemed for its rich and agreeable flavour, and seems to be relished not only by man, but by many kinds of animals.

668. Several of the Laurineæ are diœcious; and this is constantly the case with the *Nutmeg* tribe, which is nearly allied to them; in these, neither the stamineous nor the pistilline flowers contain a trace of the deficient organs. The nutmeg is the single seed contained within the ovarium, which, in ripening, forms a fleshy fruit (not unlike the Apricot in appearance) that bursts into two halves, displaying the seeds in its centre. The nutmeg is

partly enveloped in a covering to which there is nothing analogous in most tribes of plants; this is called the *arillus;* and it is known as *mace.* The mace lies between the fleshy fruit and the contained seed; it does not form a complete covering, having many large apertures, through which the dark seed appears. It is, when fresh, of a bright scarlet colour; but this changes in drying to a dull yellowish brown.* The Nutmeg was originally grown only in a small group of islands in the Eastern Archipelago, termed the Banda or Spice islands, of which the Dutch early obtained possession. That nation desired to secure to themselves the trade in this valuable spice; and they endeavoured so to regulate the quantity produced, that the price of it should be always kept up to a high standard. Sometimes they cut down trees; and in other instances, when the crop was too abundant, they even destroyed immense quantities of the spice. They more than once, however, suffered dearly for their avarice; the nutmeg trees of Banda having been nearly destroyed by the hurricanes and earthquakes, which spared other islands. The nutmeg has now been for some time cultivated by the English in Sumatra, and also in the West Indies. Although the quantity produced in the last-named islands has hitherto been very small, there can be little doubt that, if the trees received greater attention, it might be much increased; but the attention of the planters is unfortunately so much fixed upon a few objects,—such as Sugar, Coffee, Cocoa, and Cotton, which yield an immediate return, that they are apt to neglect what might ultimately be more profitable, especially if it do not succeed on a first trial. The quantity of nutmegs imported into Britain in 1839 was about 280,000 lbs; but of this not quite half was kept for use in this country. Several species of this order bear aromatic fruits; but they are all much inferior to the true nutmeg.

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* When it is desired to preserve the nutmeg and mace as a curiosity, the best way to prevent the loss of the beautiful colour of the latter, is to keep the fruit in a thick syrup, made from the best white sugar.

669. Passing over several less interesting tribes, we come to one of great extent and importance,—the EUPHORBIACEÆ, or *Spurge* tribe, which is an order containing a large number of plants distinguished for their extreme acridity, and mostly inhabiting tropical countries. A small number are natives of this country; and a few more are cultivated in our gardens. It is fortunate, considering the injurious properties of this order, that it should be easily distinguished from all others. The stems, leaves, &c. have a milky juice; the stamens and pistils are not contained in the same flowers; and the fruit ordinarily splits into three divisions when ripe. The general structure of the flower cannot be readily understood by examining the common Euphorbias of this country; since they have a peculiarity which is characteristic of the genus. If the apparent flower of one of the Spurges be examined, it will be found to consist of a sort of cup divided into ten parts at its edge, and having a cluster of stamens arising from its bottom; with a long stalk in the middle, curved downwards by the weight of the ovary that grows upon its summit. These stamens are peculiar, from the circumstance of their having a joint in what appears the filament of each; and also in their *successively* growing up above the mouth of the cup, discharging their pollen, and then shrivelling up. It was formerly supposed that the whole of this structure constitutes one flower; and as the young Botanist would be likely so to consider it, it is desirable to explain the reasons why it is not now so regarded. In the first place no other genus of this order has stamens and pistils united in the same flower. Again, there is no other flower in which the stamens have jointed filaments, or the same confused arrangement. Further, in many species, a sort of cup-like membrane springs from this joint, much resembling a little calyx. For these and other reasons, each supposed stamen is now regarded as a single stamineous flower, and the portion of its filament below the joint as its flower-stalk; the ovary in the centre is in like manner a pistilline flower; whilst the cup from which they spring is an *involucrum* of bracts, something like that of the Compositæ (§ 629);—the whole being thus a kind of *head*, rather than a single flower.

In general the floral leaves are green, so that the whole flower is almost destitute of colour; but sometimes they present most brilliant hues.

670. In other genera of the order, the structure does not depart so widely from the ordinary type. In some of them we even find a double perianth, each whorl being usually made up of 5 or 6 divisions. The stamens are extremely variable in number; and the ovarium consists of 3 carpels, (sometimes only 2) which separate from each other in ripening; each of these encloses one or two ovules. A very good illustration of this structure is found in the *Palma Christi*, or Castor-oil Plant, which is often cultivated in gardens, on account of the handsome appearance of its leaves and clusters of flowers. Many of this order are very succulent; and several of the tropical species present very much the appearance of the Cacteæ, being leafless, and having their swollen stems beset with spines. Nearly all of this tribe possess acrid properties in a greater or less degree; but these are most powerful in the roots of the larger species which are not of annual growth. In Africa and Asia the leafless thorny Euphorbias are often planted for fences; and they serve most effectually to keep out intruders, injuring those who attempt to pass, not only by their sharp spines, but by the acrid juices which they instil into the wounds made by these. One of the most violent in its action of all the species of this order, is the Manchinell tree of the West Indies; the juice of which, when applied to the skin, produces corroding ulcers. It has been said that it is dangerous even to remain under the shadow of the tree, but this is an exaggeration; it has been stated on good authority, however, that, if a person take refuge under one of these trees from a shower of rain, the droppings become charged with its exudations, and produce troublesome sores on any part of the skin which they may touch. The juice of this and of many other trees has been used to poison arrows.

671. Although the juices of the leaves and stem are usually so acrid, other parts of the plant may be applied to various uses, either as articles of food, or as valuable medicines. Thus the root of the *Jatropha Manihot* contains a large quantity of starchy

matter; and this is easily freed from the acrid juice by pressure and by heat, so as to be rendered quite wholesome; and in this state it constitutes a most important article of food, under the name of Cassava, through a large proportion of the tropical countries inhabited by man. The oil of the seeds of the Castor-Oil plant is one of the mildest purgatives known; but that of the seed-coats is very acrid and dangerous. The seeds of the *Croton tiglium*, and of the *Jatropha Curcas*, or Physic-nut of the West Indies, also furnish an acrid oil, which is used in medicine as an active purgative and emetic. There are some species of which the juices are not strongly acrid; but all are suspicious. Besides these products, there is one that is obtained in considerable amount from this order, the value of which is every day becoming greater, from the new and varied uses to which it is applied. This is *Caoutchouc*, (§ 367—9); which, although partly obtained from a tribe to be presently mentioned, exists in considerable amount in the Euphorbiaceæ. This order presents itself in the largest proportion in tropical America.

672. Another important group, also widely extended, and affording many products of importance to man, is that of URTICEÆ, the *Nettle* tribe. It will doubtless surprise those, who have no previous botanical knowledge, to learn that the Fig, the Bread-fruit, and the Nettle, belong to the same group, along with the Hemp, Mulberry, and Hop. However much these differ among themselves, they agree in certain general characters, which distinguish them from all others. These characters may be most readily seen in such plants as the common *Pellitory*, that grows on wall-tops and in waste places; in which the flowers are not crowded together, as they will be shown to be in the Fig and Bread-fruit, and in which the stinging hairs of the Nettle and its allies are not present. Of the flowers of this plant, as in the whole order, a part are stamineous and a part pistilline; there are here, besides, some others which are complete, though the pistil of these is not fully developed. The perianth is divided into four lobes; and *opposite* to the base of each arises a stamen. This last character is common to the order; but the number of segments of

the perianth differs. The pistil consists of one ovary containing a single seed; it is surmounted by a single style, with a stigma composed of a bunch of filaments like a brush; in other species there are very commonly two styles. The fruit contains but a single seed, and is closely wrapped round by the perianth, which does not fall off.

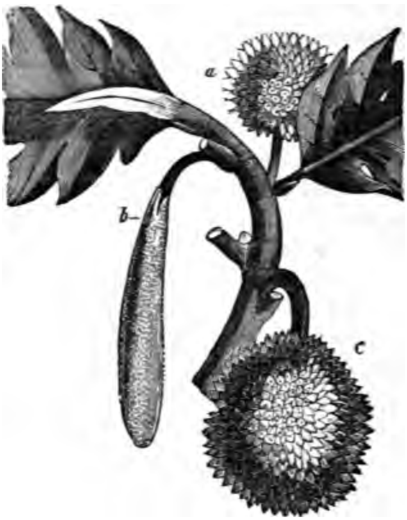

Fig. 103. Branch of Bread-fruit tree, bearing *a*, *c*, clusters of pistilline flowers; *b*, cluster of stamineous flowers.

673. The greatest peculiarity in the organs of fructification, by which the Bread-fruit, Fig, &c. is distinguished, is not that the flowers are different in themselves, but that they are crowded together *upon* or *within* a receptacle. This will be readily understood, so far as the Bread-fruit is concerned, from the accompanying figures. The stamineous and pistilline flowers grow in separate clusters, which are of different forms; that bearing the former is long, resembling a catkin; that of the latter is more globular, its bulk being principally composed of the fleshy receptacle on which the flowers are seated. The

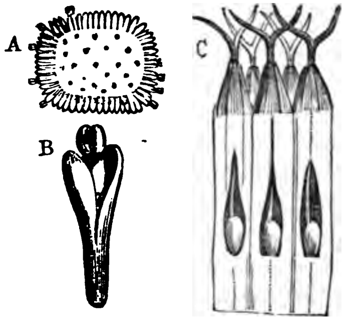

Fig. 104. A, section of cluster of stamineous flowers; B, single flower; C, three pistilline flowers, enlarged.

flowers are so much crowded together, that the perianth forms a cylindrical tube, composed of two pieces only. This, in the stamineous flowers, contains but a single stamen; and, in the pistilline flowers it envelopes a one-celled and one-seeded ovarium. During the ripening of the fruit, the receptacle enlarges, and becomes still more fleshy and succulent; and it is this which constitutes the edible portion. The structure of the Fig is extremely analogous to this; except that the flowers are borne on the inside of a hollow receptacle. This would not be understood, if the dry Fig only is thought of; but, if the unripe Fig be cut open, its structure is at once perceived. Its firm fleshy exterior is the receptacle, which has grown up around the flowers, so as to direct them inwards towards each other, as if they were growing on the inside of a bason; this is not completely closed over at the top, however; for a little aperture is left there, which serves a very important purpose. The stamineous and pistilline flowers are both included in the same receptacle; but being so much crowded, the pollen of the former would not become applied to the stigmas of the latter, without some special contrivance. This is accomplished by the agency of insects, which enter the cavity through the hole at the top, and disperse the pollen by their movements. The seeds, which we meet with in the ripe Fig, are in reality little grains or nuts; being the hardened ovaries, closely enveloping the true seed, like those of the Rhanunculaceæ.

674. We have now briefly to notice the chief products of this order, which is surpassed by very few in its importance to man. The Bread-fruit is the chief support of the natives of a large proportion of the islands that are scattered through the Southern Ocean; it was introduced by the British Government into the West Indian Islands, where it grows very well; but is not much relished by the negroes. The timber of this tree is light, and is used for building houses and boats; and the inner bark is beaten into a kind of cloth. Nearly allied to the Bread-fruit is the Mulberry, which is well known to be the source of all our silken fabrics, as upon its leaves alone can silk-worms be profitably reared. The Paper-Mulberry affords the material of paper to the

Chinese and Japanese, the inner bark being beaten into a pulp, and then pressed into sheets; and its juice is so tenacious as to be useful as a glue. The Fig is an important article of food in many Eastern Countries; and it is highly nutritious as well as agreeable. A very large quantity is exported from these to various parts of Europe; as much as 1000 tons are annually brought to Great Britain alone, chiefly from Turkey and the Levant. Nearly allied to the Fig is the celebrated Banyan-tree of India; (§ 152) and also the famous Upas, which has been reputed to be the most poisonous species of the whole Vegetable kingdom, causing the death of animals which even approached it, or of birds which fly over it. It is quite true that its juice acts as an extremely violent poison, when inserted into a wound; but the other effects attributed to the tree are not founded in fact. The Trumpet-wood of tropical climates affords the means of constructing canoes, furniture, &c; and its fibrous parts are used as cordage; the same portion of the Hemp-plant of northern regions, supplies the material not only of our rope and twine, but of many of our coarser woven fabrics, such as sail-cloth. In India, hemp is cultivated for the sake of the properties of its leaves, which have an intoxicating power, resembling that of opium. This valuable plant will grow in almost any climate and any soil; the country in which it is most cultivated, however, is Russia, whence a large quantity is annually imported into Britain. The amount of hemp of foreign growth, employed in the country in 1839, was nearly one million hundred-weight. The fibres are separated and prepared very much in the manner of those of Flax. It is curious that the Hemp-plant destroys almost every other plant that grows in its neighbourhood; so that it has been sometimes employed to clear from weeds a tract, which is afterwards to be used for some other kind of cultivation. The chief product of this order that now remains to be noticed is Hops; this consists of the little scales, which form a sort of cone like that of the Fir, having a small pistilline flower at the base of each; these scales are to be regarded as bracts. This plant is not a native of Britain, having been introduced from Flanders about three centuries ago; but it is now very extensively cultivated, as much as 56,000 acres being ıployed for hop-gardens, of which nearly all are situated in the ınties of Kent, Sussex, Worcester, and Hereford. The duty on their growth is heavy; and the crop is an extremely ıcertain one; so that the price is frequently high, and is liable great fluctuations. In 1837, the excise duty on the hops grown England amounted to nearly £311,000, of which the county Kent contributed one half. Besides their use in brewing, hops ıy be made serviceable, through their narcotic properties, in ocuring sleep; the use of a pillow stuffed with them has been ıch recommended in cases of habitual wakefulness.

675. The small order **Piperaceæ**, the *Pepper* tribe, claims tice on account of its utility to man. Several hundred species are now known; but they all so closely resemble each other, as to form no more than two genera. They are all tropical plants, abounding in the hottest regions; and they all possess, in a greater or less degree, the pungent aromatic principle familiar to us. The Exogenous character of the group is by no means distinct; so that it has been placed by some Botanists among Endogens, more especially as in most species there is but a single cotyledon. The structure of the flowers is extremely simple. No vestige of the perianth remains, except a little scale, which is probably to be regarded as a bract; this protects the organs of fructification, which consist of a

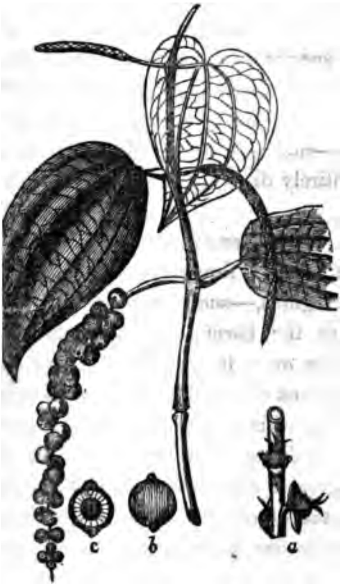

Fig. 105. Branch of Black Pepper, with ikes of unopened flowers above, and of uit below; *a*, portion of flower-stem, with ree flowers; *b*, single fruit; *c*, the same it open.

one-celled ovarium; surmounted by a stigma cleft into two or three divisions, and surrounded by two or three stamens partly adherent to it. These simple flowers are clustered together in spikes; this is also the arrangement of the ripened grains, which consist of the ovarium enclosing the seed. These are known as *black* pepper; and it is when deprived of their husk, that they constitute *white* pepper; which is less pungent. The annual crop of each pepper-plant varies from half a pound to a pound; and the whole quantity collected every year for human consumption is probably not far short of *fifty million* pounds. Of this a much larger proportion is consumed in tropical countries, the inhabitants of which are fond of highly-seasoned dishes, than in Europe; nevertheless, nearly ten million pounds are annually imported into Britain, of which only about one-fourth is consumed in the country. Pepper from other species forms a small proportion of the whole; *long* pepper, as it is termed, is the unripe cluster of flowers, which has nearly similar properties with the fruit. Cayenne pepper, as it is termed,—more properly Capsicum, is the seed-vessel of a plant of an entirely different natural order,—that of Solaneæ.

676. We now come to a very extensive group, which comprehends a large proportion of the forest trees of our own country and other temperate regions,—such as the Oak, Beech, Elm, Plane, and Poplar, with the Birch, Willow, and many others. The name given to the order is AMENTACEÆ, or *Catkin* tribe, on account of the arrangement of the flowers in most of the species, forming what is called a catkin;* but this arrangement is not universal. There is, indeed, considerable variety in this respect, as well as in the degree of completeness of the flowers, which sometimes contain both sets of organs, whilst in general the stamineous and pistilline flowers are distinct, sometimes, even,

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* A *catkin* is a long flower-stalk on which the flowers are closely set; and differs from a *spike* only in this,—that the whole falls off together, as is seen in the Poplar or Willow.

being on separate trees. They all agree, however, in the simple structure of the flowers, as well as in other particulars. When the stamineous flowers are distinct, they are generally destitute of perianth, but the stamens spring from a sort of scaly disk; they are usually clustered together, either on a long stalk, forming a *catkin*, or on a sort of *head*. The pistilline flowers commonly possess a perianth in one whorl; they are sometimes solitary, and sometimes arranged on a catkin. What may be regarded as the most characteristic structure of the group is seen in the *Poplar* and *Willow*. In these, the stamineous flowers are on one plant, and the pistilline on another; and both are arranged in catkins. Each of the former consists of a little bract, protecting one or many stamens; and each of the latter consists of a nearly similar bract, on which is set an one-celled ovarium containing many ovules. The fruit opens by two valves, which discharge a multitude of small seeds, covered with fine hair or wool, like the seeds of the Cotton plant. The Willow has no trace of a real calyx; but the Poplar has a sort of membranous cup, which may be considered as the rudiment of one.

677. A nearly similar structure is seen in the common *Hazel;* in which, however, the two kinds of flowers are arranged on the same tree; and the fruit more resembles that of the Oak. The stamineous flowers grow in catkins; but the pistilline flowers, grow near these, clustered together within a scaly envelope which looks like a little bud. At the time when the stamens are shedding their pollen, the clusters will be recognized by the little red threads protruding from their points, which are the stigmas. The ovarium will be found carefully enclosed in the scales of which the bud consists, and protected by a quantity of soft hair. The ovarium contains two cells, with an ovule in each; but only one of these comes to perfection. The fertilization of the seed is ensured by the immense quantity of the pollen discharged from the numerous anthers, which settles upon everything around as a fine dust. Each pistil has a sort of imperfect calyx arising *above* the ovary, the remains of which may be traced at the point of the nut; but it is also enclosed in an involucrum of bracts, which increases as

the fruit ripens, and almost envelopes it, forming the *husk* of the nut. When the spring is mild, all the ovaria are fertilized, and the nuts ripen in clusters; but in cold springs it often happens that some of the pistilline flowers are destroyed, so that only single nuts are found in the place of the clusters. In the *Oak* and *Elm* the calyx is much more definite; and the involucrum is very peculiar in its structure, hardening into the well-known *cup* of the Acorn, Beech-mast, &c. The cells and ovules contained in the ovary are frequently numerous; but only one seed usually comes to perfection.

678. The importance of this order, on account of the valuable timber which it yields, is so well known, that it need not be here dwelt upon. It may be well to mention, however, that in propagating the various species, great care should be taken to select those whose wood is most durable. There is a remarkable difference in this respect between two species of Oak, which are commonly grown in this country. Of one, which has the acorn-stalks *long* and the leaves *short*, the timber is close-grained, solid, and not liable to rot; whilst the other, which has the acorn-stalks *short*, and the leaves *long*, affords a wood of much looser texture, very apt to decay. The former is the Old English Oak, of which those ancient fabrics are constructed, that have resisted the ravages of time for many hundred years. The latter was probably introduced from the continent about three hundred years since; and being more easily propagated, and of quicker growth than the other, it has been latterly substituted for it, especially in the New Forest, in the Northern counties, and in the neighbourhood of London. It is not unlikely that the late prevalence of dry-rot in our dock-yards is due to this cause.

679. Next to timber, the most important product of this order is *Cork*, which is a portion of the bark of a species of Oak common in the South of Europe. This peculiar substance, which consists entirely of cellular tissue, exists in many trees; but it is most abundantly found, and most quickly renewed, in this one. The cork is first taken off when the tree is about fifteen years old, and the next crop is removed ten years after; these two, however,

are of little value, being thin and full of fissures. Afterwards the operation is repeated every eight or ten years; and a tree thus barked will live a hundred and fifty years. The importance of the secretions of *tannin* and *gallic acid*, which are afforded by the bark, acorn-cups, and gall-nuts of this order, has been formerly dwelt on (§ 364 and 399). Willow bark contains a bitter principle, which has been used in medicine as a substitute for that obtained from the Peruvian Bark. The *Myrica cerifera*, or Wax-plant of North America (§ 381), is a species of this order, allied to the Gale or Dutch Myrtle of this country.

680. The last order to be noticed in this group differs so remarkably from all the rest, and in fact from all other Exogens, that some Botanists consider it in the light of a separate class. This is the order CONIFERÆ, all the members of which are distinguished by their fructification, which is borne in *cones*, of which those of the common Fir, Larch, &c., are examples. These cones consist of a number of thick hard scales, which are adherent together until the organs of fructification are nearly mature, when they separate, so that the structure of the parts within can be distinguished. At the bottom of each of these scales are two ovules, which are not enclosed in any thing like a seed-vessel. Hence these are the only true naked-seeded or gymnospermous Exogens; and the peculiarity is a very striking one. The dense scales were formerly considered as bracts; but little bracts may be often found at their base; and they are now regarded as the carpellary leaves, which have not folded in to enclose the ovules (§ 462). The stamineous flowers are arranged in catkins, much resembling those of the last order. The pollen grains fall directly upon the open points of the ovules; so that the process of fertilization is here as direct as it possibly can be. The seed is remarkable for having, in many species, a sort of verticil of cotyledons instead of two only; but these arise in the same manner as the two which we find in other Dicotyledonous plants, and may be regarded in the same light as leaves which present a corresponding sub-division. (§ 234.)

681. The Coniferæ certainly present the nearest approach to

Cryptogamia, which we anywhere find in the class of Exogens. Their organs of fructification are reduced to the simplest form they can possess, whilst still maintaining the character which distinguishes the reproductive process in Flowering-plants. (§ 431). In the mode of growth of their stems, they are clearly Exogenous; differing from other trees of that class in little, except that they do not possess ducts, and that their woody fibre is of large diameter, and possesses glandular dots (§ 78). It is extremely interesting to be able to prove, by examination of such minute points of structure, the real nature of those vast deposits of Coal, which have long been a source of perplexity to those, who interest themselves in enquiries into the history of our globe. Although in most instances the structure of Coal has been so much altered by the combined agency of water, heat, and pressure, that it cannot be clearly distinguished, pieces may not unfrequently be found, in which it is very evident, when examined with the Microscope. It is then seen to correspond with Coniferous wood, both in the characters which have been just mentioned, and also in the presence of a number of little receptacles for secretion, in which a fluid is contained. This fluid may be separated by distillation at a temperature beneath that of boiling water; and it is found to be identical with Oil of Turpentine. It has been supposed, from the abundance of these remains of Pine forests, and from the absence, in the same deposits, of remains of wood of higher tribes of Plants, whilst the stems and leaves of Tree-ferns have been most perfectly preserved, that none of those higher tribes existed on the Earth's surface at that period. This inference, however, must not be relied on; for it has been found, by placing pieces of various kinds of wood, with Fern-leaves, and other Cryptogamic structures, to decay together in water, that, whilst all traces of Oak, Elm, Beech, and other hard woods were lost, the Coniferous woods could be distinguished, as could also the Palms; whilst the Ferns underwent little alteration. If such a process took place, as is probable, at a former period, the remains would be just what we find them; although many of the more perfect Exogens might have contributed to form them.

682. The various species of this order are distributed, as is well known, over the whole globe; but they principally abound in temperate latitudes, and flourish on the sides of lofty hills, where no other trees will grow. They are of great service in rendering ground fertile for other kind of vegetation, by the decay of their leaves and resinous excretions, at the same time that they are themselves a source of profit. Some species grow to an enormous height,—as much as 230 feet, with a perfectly straight stem. Every one is acquainted with the value of *deal* timber; on account of its softness combined with elasticity and firmness, the size at which it may be readily obtained, the ease with which it may be worked. The greatest part of that which is used in this country is brought either from Canada, or from Sweden, Norway, and Russia; the latter, which is called Baltic timber, is of the best quality, but is partly kept out by a heavier duty. The total quantity imported is probably a great deal more than *a million loads* per annum,—by far the most bulky product which is brought to this country; the amount contributed to the revenue by the duty paid on it, is about a million and a half sterling annually.

683. The general characters of the foregoing orders are so distinct, that they will not be made more evident by being arranged in a table.

CLASS II. ENDOGENS.

684. The number of orders belonging to this division of the Phanerogamia is much less than that of the Exogenous class; and many of these are of little importance to man. There is one, however, which surpasses all others in the benefits, direct and indirect, which the human race derives from it. This is not, as might be imagined, an order consisting of lofty trees, whose stems and branches afford valuable timber, whose fruits serve as wholesome and nutritious food, and whose juices possess properties that render them valuable as medicines; but a tribe containing few save humble and apparently insignificant plants, undistinguished either by the beauty of their flowers, the fragrance of their odours, or the delicacy of their leaves; and having nothing in their general aspect, which could afford the slightest indication of their value, This order is that of the Grasses, which affords to man his entire supply of the most nutritious of all vegetable substances, and on which are almost entirely supported the domestic animals which he rears for the food they yield, and for the other valuable products derived from them. We shall hereafter find that this order ranks very low in the scale, considered in regard to its structure alone; and it is interesting to observe, in this as in so many other instances, the apparently insignificant means which the All-Wise Creator employs to effect objects of the greatest magnitude. It will be remembered that, in the class of ENDOGENS, the parts of the flower are generally arranged in *threes*, not in *fours* or *fives*.

685. The first order to be noticed is a small one, containing the British aquatic plants named Frog-bit (*Hydrocharis*) and Water Soldier (*Stratiotes*), as well as many foreign species, especially in North America where it is most common; the first-named of these plants may be regarded as the type of the group, it is named after it HYDROCHARIDEÆ. The *Frog-bit*, (sometimes formerly called the lesser Water-lily from its supposed resemblance to the plants of the order Nymphaceæ) is common in many ditches and ponds in this country; it has long stems which float on the water,

sending down roots at intervals below, and erecting its leaves and flower-stems a little above the surface. The veins of the leaves run nearly parallel from the foot-stalk to the apex, and are united by little cross bars. The staminiferous and pistilliferous flowers are here distinct; the former are sometimes called *barren* flowers in botanical works, because they do not bear seeds, whilst the latter are spoken of as the *fertile* flowers. This is an incorrect application of terms, since the pistilliferous flowers can no more produce seed without the pollen of the staminiferous, than the latter can without the ovules of the former. In both kinds of flowers, we find a calyx of three sepals, surrounding a corolla with three petals. In the Frog-bit there are nine stamens, disposed in three rows, on the one flower; and within these, three imperfect styles: but in other species, the number of stamens is indefinite. The other flower is destitute of stamens, and has an inferior ovarium, consisting of six adherent carpels, with separate styles and stigmas, each carpel containing numerous ovules. In some of the order, the partitions dividing the seed-vessel give way, so that the ovarium contains but a single cell.

686. The *Stratiotes*, which has been so named from its sword-shaped leaves and its fancied military appearance, is a very ornamental aquatic. It remains submerged during the greater part of the year, but raises itself to the surface on special stalks during the flowering season, by means of which contrivance the pollen may be scattered upon the stigmata. A still more curious means of effecting this object is met with, however, in another plant of the order, the *Vallisneria*. This plant, unlike the two already named, which prefer still waters, grows in rivers and rapid streams, of which the level is undergoing frequent and considerable variations. Now it is essential to the well-being of the plant, both in regard to the fertilization of the seed and the ripening of the ovule, that the pistilline flowers, from the time of their expansion, should be kept on the surface of the water, and secured from frequent submersion. This is effected by a very curious contrivance. They are themselves so constructed as to be lighter than water, and they are mounted on long cork-screw-like stalks, which are endowed with elasticity

enough to enable them to extend when the surface of the water rises, just like a spiral spring when it is stretched out; whilst these contract again as the water sinks, so as still to keep the flower in close apposition with the plant. But the staminiferous flowers have no such provision; and as these grow from the part of the plant which is continually submerged, it would not seem evident how they are to come into proximity with the others, more especially as they commonly grow from separate roots. It has been observed, however, that, when the pollen is mature, and the anthers are ready to burst, the flowers producing it detach themselves; and, rising by their lightness to the surface of the water, they mingle with those already floating there, and discharge upon them their pollen, as soon as their petals are expanded under the influence of the sun. It has been further observed that, when the seeds are ripened, the spiral peduncle again contracts; and, carrying down the capsule, buries it in the mud.

687. The plants of this order are found in the ponds and streams of most countries; scarcely any of them, however, have been applied to any useful purpose; and none are characterized by any remarkable properties.

688. Another small order of aquatic Endogens is the one to which the *Sagittaria* (§ 227) belongs; it also includes a still more common plant, the *Alisma Plantago*, or Water Plantain, from which the name of the order ALISMACEÆ, is derived. These are alike in most respects in the structure of the parts of fructification; but the former has the pistilline and staminiferous flowers distinct (hence belonging to the Linnæan class Monœcia), whilst the latter has the two sets of organs united in each flower (and hence belongs to the Linnean class Hexandria)· the former also has more stamens than the latter. The Water Plantain has oblong, heart-shaped, pointed leaves, marked with about seven

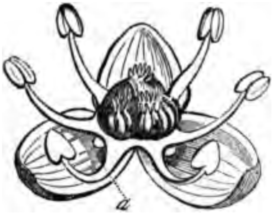


Fig. 106. Flower of Alisma Plantago, with the corolla removed, showing three sepals of calyx, and six stamens; *a*, undeveloped stamen.

nearly parallel ribs or principal veins: and these are united by cross-bars, so that a kind of network is formed. The calyx consists of three distinct green sepals; and the corolla of three delicate pink or white petals. There are six stamens in this species of Alisma, *two* placed opposite each sepal; so that there must evidently be some portion of the flower deficient; since neither of these stamens corresponds with the centre of the sepal, as it should truly do, but each with one of its edges. Upon a more minute examination, a little glandular body may be found at the base of each sepal, and between each pair of stamens; this is obviously a rudimentary stamen, and thus the whole form an undeveloped whorl perfectly opposite to the sepals. But neither of the six stamens stand opposite the petals, as one whorl should do if the flower were regular; so that we must imagine the rudiments of another row to exist in a state of still more complete want of development. In reality, then, the flower of Alisma, although containing six stamens, or two whorls only, must be regarded as constructed upon the plan of twelve stamens in four whorls, of which the outer can only be traced in a rudimentary state, the second being entirely deficient, and the two inner ones only being apparent. This scheme of suppression of parts may be expressed thus;—

1	Sep.		Sep.		Sep.	
2		Pet.		Pet.		Pet.
3	s		s		s	
4		o		o		o
5	st		st		st	
6		st		st		st

The first line represents the position of the sepals; the second that of the petals alternating with them; the third that of the rudimentary stamens opposite the centre of the sepals; the fourth that of the deficient stamens, which should be opposite to the petals; and the fifth and sixth, the rows actually present, the position of which does not properly correspond with that of the outer whorls of the flower. Now this view of the matter, which may be considered forced and speculative, is very interesting when it is compared with the fact, that the tendency to the production of one or two additional whorls of stamens, which have been inferred to exist in this instance, is actually manifested in other species of Alisma, one of which has nine, and another twelve stamens. Had the six stamens been in the position represented in the third and fourth lines, there would have been no reason to suppose that any more existed in an undeveloped state, or that the plant was likely to be allied to any with 9 or 12 of these organs. The ovaries of the Alisma Plantago consist of about twenty-four (eight times three) carpels, which are quite distinct from each other, every one having its own style and stigma; they are arranged in a somewhat triangular manner, in three clusters. The number varies in other species, and may be regarded as indefinite. In all instances, there is one ovule in each cell; and the fruit consists of a triangular head of dry one-seeded nuts, very much resembling that of the Ranunculaceæ. From the aquatic species of that order, indeed, in which the veining of the leaves departs from the regular Exogenous character, and the parts of the flower are arranged in threes, this group is not far distant; and this is one of the instances which show that even the most positively-defined groups are liable to approach one another, through aberrant forms, in which the characteristic peculiarities of each are shaded off, until they almost blend together.

689. Some Botanists separate from this order the *Butomus* or Flowering-Rush, and its allies, on account of the inner surface of the sepals being coloured like the petals; this plant receives its scientific name (which means cut-mouth) from the injury done by the sharp leaves to the mouths of the cattle that browse upon them. There is a marked difference in the properties of the two groups; for the British species of Butomus is one of the most acrid of our native plants, its leaves being sometimes used as a purgative, whilst the Alismaceæ are much less so, and the rhizoma or horizontal stem, which is fleshy in some species, is eaten as food by the Tartars and Chinese.

690. The next two orders, both consisting of aquatic plants, may be considered as presenting a near approach to the aquatic Cryptogamia in general structure; and some species are very like

Algæ in external aspect. They are clearly separated from them, however, by their organs of fructification; but these seem reduced to almost their simplest possible form. In the common *Duckweed*, for example, of which almost every pond will supply us with specimens, the whole plant consists of a little green scale, looking like a leaf, but really a compound of stem and leaf, from the under side of which, as it floats on the water, hangs down a single root-fibre. Few persons are aware that the Duckweed ever flowers; indeed there are some kinds which appear to reproduce themselves only by buds, as no organs of fructification can be detected; but, if properly sought for, the flowers of this little plant may usually be seen in the months of June or July. If the eyes be attentively fixed on a mass of it, on a still sunshiny day, a few minute straw-coloured specks may very probably be discovered here and there upon the edges of the plants; they have a sparkling appearance, which attracts observation. These are the anthers; and if the plants possessing them be more carefully examined, especially under a microscope, the whole flower will come into view, having been previously hidden in a slit in the edge of the scale. The flower consists of a transparent membranous bag, having a split on one side, through which the two stamens pass out; and within is a single-celled ovary, having a single style and stigma. The sheath that encloses these is probably to be regarded as a large bract or spathe, like that which will be particularly described in the Arum tribe. Such are the means by which this little plant propagates itself, which it sometimes does with amazing rapidity. The Duckweed is so named, from its being a favourite article of food with water-fowl. It is the only genus of its kind known in Europe; and from its scientific name, *Lemna*, the group of which it may be considered as the type,

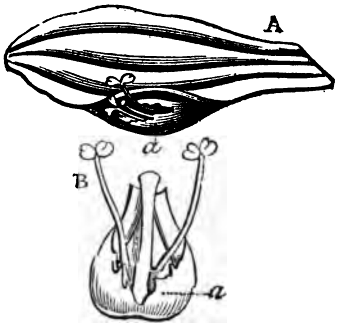


Fig. 107. A, scale of Duckweed, with flower *a* at its edge. B, the flower separated.

is called LEMNACEÆ. In tropical countries, the surface of the water in ponds, tanks, &c. is often covered with a sort of gigantic Duck-weed, with a more highly organized flower, termed *Pistia;* this has acrid properties, with which it is said to impregnate the water to such a degree as to make it unwholesome. Neither *Lemna* nor *Pistia* have spiral vessels; so that in this respect they might be associated with Cryptogamia.

691. In the order NAIADEÆ, we have almost as near an approach towards flowerless plants; they are believed to be equally destitute of true spiral vessels; and they possess no distinct cuticle. In their general form and habits many of them strikingly resemble Algæ; from which, however, they are at once distinguished when in flower. Of the British species, this resemblance is the strongest in the *Zostera marina*, or Grass-wrack, which is abundant on many parts of our coasts, and in the creeks and salt-water lakes that pass inland. It is used, where it is common, for packing glass bottles and earthenware; and also in cottages for making beds and cushions. The Pond-weed *(Potamogeton)* of which a large number of species exist in Britain, is another plant of this order; its roots are fed on by swans, which devour them with avidity, whilst its seeds are a favourite article with ducks. One species is said to grow in the Swiss lakes to the length of from ten to twenty fathoms, forming as it were extensive subaquatic forests, in those vast natural reservoirs; in Siberia the roots of the species which most abounds there, are used as food by man. The flowers of the plants of this order have a calyx and corolla, each consisting of two little scales, which very early fall off. Some species are monœcious, whilst others possess complete flowers. The stamens and carpels exist in a small definite number; but this varies in the different species. In *Potamogeton* there are in each flower four anthers, which, not being elevated upon filaments, are said to be sessile; and four ununited carpels, with separate styles, which become four small nuts. On the other hand, *Zostera* is monœcious. The plants of this order are most abundant in countries beyond the tropics, although they are also found near the equator. Potamogetons exist in almost every ditch and swamp as far north as Iceland.

Order Orchideæ, or Orchis Tribe.

692. The plants associated with the common *Orchis* in this order, exhibit some of the most curiously-interesting modifications of structure that any group in the vegetable world affords. Most of them are remarkable for the resemblance between their oddly-shaped flowers, and various objects with which they may be compared; thus two of the most common species of this country are known as the Bee-Orchis and the Fly-Orchis, from the similitude between their flowers and those insects; whilst others are known as the Man-Orchis, the Lizard-Orchis, and the Ladies' Slipper. In some foreign species there is an equally strong resemblance to large and splendid Butterflies and other insects; one, again, reminds the observer of a grinning monkey; whilst another resembles an opera-dancer suspended by the head. The accompanying figure represents the Spider-Orchis, in which the likeness to the body of that animal is very striking. The Orchideæ of Europe grow on the ground, in meadows, marshes, or woods; and they are justly considered as among the most curious and beautiful plants of its Flora. But it is in tropical countries, in damp woods, or on the sides of hills in a serene and equal climate, that they are seen in all their beauty. "Seated on the branches of living trees, or resting among the decayed bark of fallen trunks, or running over mossy rocks, or hanging above the head of the admiring traveller, suspended from the gigantic arm of some monarch of the forest, they develope flowers of the gayest colours, and the most varied forms, and often fill the woods at night with their mild and delicate fragrance.

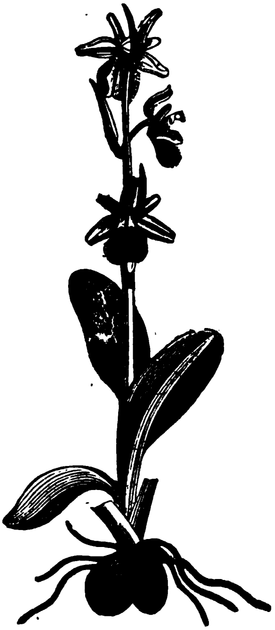


Fig. 108. Spider-Orchis.

For a long time such plants were thought incapable of being made to submit to the care of the gardener; and Europeans remained almost ignorant of the most curious tribe in the whole vegetable kingdom. But it has been discovered of late years, that by care and perseverance they may be brought to as much perfection in a hot-house as they acquire in their native woods; and they now form the pride of the best collections in England." It is chiefly in the almost impenetrable forests of South America that the *epiphytic* species (those that grow upon the surface of trees) are found; but in the hot damp parts of the East Indies other kinds are very abundant. Some epiphytic species are known as air-plants, from their power of vegetating when simply suspended in the air, without any soil or any direct supply of water, supported only by the moisture of the atmosphere; so that, when hung up by strings from the ceiling of a room, they will live for weeks and even months, and will go on blossoming luxuriantly. Hence they are some of the most favourite ornaments of the houses in China and Japan, of which countries they are natives.

693. As the structure of the flower is that which is most peculiar in this group, we shall proceed at once to a description of it. The short peduncle on which the flower seems to be borne, is in reality its ovarium, the position of which is *inferior* in this order, whilst its form is slender. This contains but one cell, having three parietal placentæ, from each of which arise a great number of ovules. On examining the leafy parts of the flower, they are seen to be six in number, very irregularly disposed. The three external ones, which are considered as the sepals of the calyx, are seen in the adjoining figure (A) pointing upwards and to the sides; the two lateral ones in some species rise towards each

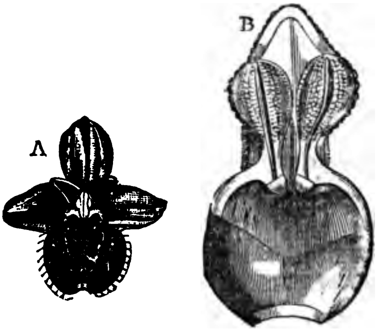


Fig. 109. A, flower of Spider Orchis, much enlarged; B, adherent anther and stigma, much enlarged.

other, and even meet and adhere, forming a sort of helmet-shaped arch, from beneath which the other parts of the flower project. The petals are also three, one of them being very much larger than the other two; the two small ones are seen in the figure to point upwards and outwards, alternating with the sepals; whilst the large one, pointing directly downwards, is that which has the greatest variety of form and colour in the different species, giving rise, by its curious metamorphoses, to the strange resemblances already alluded to. At the upper part of this transformed petal, which is termed the *labellum* or lip, is an opening that leads to a long spur which projects below. The other leafy portions of the flower are, in general, very delicately coloured on their interior side. So far, the structure of the flowers is not very difficult to understand, except in a few species in which the transformation is carried much farther.

694. The most remarkable peculiarity of the Orchideæ, however, consists in that modification of the special organs of fructification, to which Linnæus gave the name of *gynandrous*, and upon which he founded his twentieth class; and, as this is universal throughout the group and exists in no other, and thus distinguishes the Orchideæ from all other orders of the vegetable kingdom, the Linnæan class Gynandria exactly represents the order we are now considering. In the middle of the flower, just above the hole in the labellum which leads to the spur, half hidden by the petals, is a flat fleshy looking body, represented on an enlarged scael, at B. The upper part of this is seen to be divided, by a channel down its middle, into two lobes, each of which is considerably swollen at one part of the side; and over this swollen portion there is a fissure, running from one end of it to the other, which will open if the lobe be pressed. If the contents of this swelling be examined, they will be found to consist of an olive-green mass, composed of minute granules adherent together, and tapering gradually into a long stalk, by which it is attached. On examining the nature of these granules with the microscope, it is clearly seen that they are in reality pollen-grains; and that thus the whole mass corresponds with the usual contents of an

anther-lobe, in an adherent state. Hence it follows, that the whole of this curious structure is to be regarded as a metamorphosed stamen; the channel down its middle marking the division of the anther-lobes, and the fissures on the two sides being analogous to the suture or split by which other anthers discharge their contents (§ 432,3). On each side of the base of the anther is a little roundish knob, which has something of a granular character, and which is to be regarded as a rudimentary stamen. At the foot of the anther (lower part of B, Fig. 109) is a pale fleshy cup, one side of which is curved over its cavity; this is called the *hood;* and at the bottom of it is the viscid stigmatic surface. Here, then, we have the essential parts of the apparatus of fructification; only one style and one stigma, however, being developed; and these being adherent to one another. This latter character runs through the whole of the Orchideous group; as to the former, however, there is some variation. Thus, in the *Cypripedium*, or Lady's Slipper, a British Orchideous plant, the two little prominences just mentioned are fully developed into stamens, whilst the central one, which is here developed, is rudimentary; and in some other species, all three are occasionally present as complete stamens.

695. There is much difficulty in understanding how the usual influence of the pollen on the stigma can be effected in these plants; since the pollen is not capable of being scattered as a fine powder through the air, as in other plants; and if it were to fall out in a mass, it would hardly touch the stigma. Some have supposed that absolute contact of the pollen with the stigma is not necessary, and have thought that the fertilizing influence could be communicated through the stalk of the pollen-mass. But this is now proved to be incorrect; as numerous experiments have shown that the contact is as necessary here as in other plants. It is difficult to perceive, however, in what manner it is naturally effected; and recourse has even been had to the supposition, that the agency of insects is necessary, in order to drag the pollen-masses from their case, and to diffuse their granules over the stigma.

696. On turning our attention to the general aspect of the

plant, we observe that it has a fleshy root consisting of two oval tubers, and of a number of succulent fibres; that its leaves, which have the simply-veined structure characteristic of Monocotyledons, spread from the surface or the ground; and that a straight flower-stalk is shot up from the midst of these. The stem and roots are connected with but one of the tubers; the other arises as a sort of lateral bud from this one. When the stem has unfolded its flowers and ripened its fruit, it dies down to the ground, and is succeeded in the ensuing season by a stem developed from the second tuber, the first being exhausted. This, again, serves for the vegetation of one season only, and a new tuber is formed as a bud, from which the next year's stem will be developed. Hence the species possessing this kind of root, always have a pair of tubercles, one shrivelling and in process of exhaustion, the other swelling and in process of completion. Sometimes the bottom of the stem, instead of forming a new tuber upon its side, pushes out a slender subterranean root-like runner, which, after growing to some length, is arrested and forms a tuber, from which the next stem is shot up; so that the plant may be said to change its place every year to a considerable distance. In many instances the tuber is formed above the ground, constituting what is known as the *pseudo-bulb* of the Orchideæ; and its horizontal stem creeps along the surface as a rhizoma. In these cases, the structures are more permanent, the pseudo-bulbs acquiring a woody hardness, and continuing to send up stems; so that by their gradual multiplication, a large surface is often covered by a single plant.

697. It is remarkable that in a group so numerous as this,—consisting as it does of nearly two thousand known species, and of probably as many more, which being buried in the depths of unexplored tropical forests, have not yet been described,—and extending over almost the whole habitual globe as far as the borders of the frozen zone,—there should be so few species possessed of properties that make them in any way useful to man. It often happens that the most powerful virtues, or the most deadly poisons, are hidden beneath a mean and insignificant exterior; whilst those productions of nature which charm the eye with their

beauty, and delight the senses with their perfume, have the least relation with the wants of mankind. So it appears to be in this instance. The aromatic substance called *Vanilla*, which is sometimes used as an ingredient in chocolate, also to flavour sweet dishes, and to perfume snuff, is the succulent fruit of an Orchideous plant, which, in the West Indies, creeps over trees and walls like ivy. A nutritive substance termed *Salep*, somewhat resembling Arrow-root or Sago, is obtained from the tubers of a species which grows in Turkey and Persia, where it is highly esteemed. It used to be sold at the corners of the streets in London, and was a favourite drink with porters, coal-heavers, and other hard-working people, by whom it was considered very strengthening; and the comparative disuse in which it has fallen is perhaps to be regretted. It is said to contain a greater amount of nutriment in the same bulk, than any other vegetable substance; and for this reason it is much employed by travellers who have to carry their supplies with them into deserts and uninhabited countries. So high a nutritive power has been assigned to it, that it has been asserted that one ounce of Salep, boiled with an equal quantity of the stiff glue or animal jelly known as portable soup, in two quarts of water, will suffice for the daily nourishment of an able-bodied man. Some of the South American species contain a viscid substance, which, when separated by boiling, serves as a sort of glue which is used by the Brazilians for sticking together their skins of leather. There is scarcely any other way in which this order is of any direct utility to man.

698. Of the next order, SCITAMINEÆ, the Ginger tribe, there are no British representatives; but its structure will be very easily comprehended, as we now return to a nearly regular type of structure. They are all aromatic herbaceous plants, only coming to perfection between the tropics; and they are nearly all characterised by possessing a rhizoma, which creeps along the ground, and from the sides of which the leaf and flower-stalks are annually shot up. The flowers arise from expanded scaly bodies, which are clusters of bracts, one for the protection of each pair of buds. The ovarium, as in the Orchideæ, is inferior; and the calyx, which arises

from its summit, is tubular, and is formed by three sepals adherent nearly to their points. Within this are two whorls of leafy organs, the outer of which is to be regarded as the true corolla, whilst the inner one consists of transformed stamens. In each whorl there are three segments; those of the outer whorl, or petals, are partly adherent so as to form a tube, and are nearly equal,—one being sometimes larger than the rest or differently shaped, so as to show some affinity with the Orchideæ. Of the inner whorl of transformed stamens, one is usually very much enlarged, like the labellum of Orchideæ, whilst the others are almost undeveloped. Within this whorl, there are three distinct stamens, of which, however, only one usually bears pollen; but this is quite distinct from the pistil. The ovarium is usually three-celled, though sometimes imperfectly so, the partitions not being complete, so as to approach that of the Orchideæ in character. The style is long and thread-like, dilated into an expanded stigma at the top. The fruit is generally a three-celled capsule.

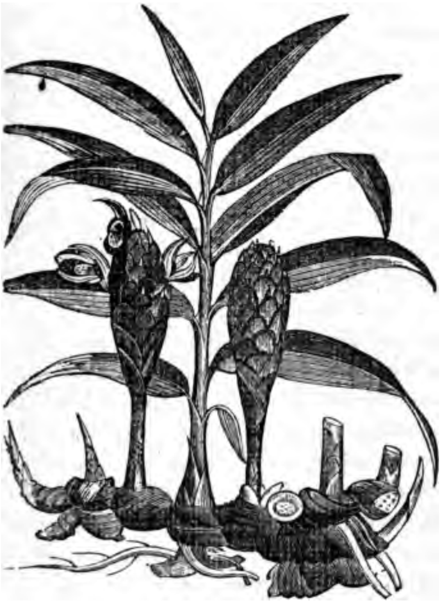


Fig. 110. Ginger Plant.

699. These plants are generally objects of great beauty, either on account of the high degree of development of the coloured parts of the flower itself, or because of the rich and glowing hues of the bracts. They are, however, principally valued on account of the aromatic and stimulating properties, which the rhizoma of most

species possesses. This is best known in the common Ginger, which is produced from a plant originally found in the south-east of Asia and the adjoining islands, but early transplanted to America and the West Indies, where it has been cultivated with great success, the Jamaica Ginger being esteemed much superior in quality to the East Indian. The dry Ginger of commerce is distinguished into white and black; but the difference of colour wholly depends upon the mode of preparation. For both these kinds, the rhizoma is allowed to remain, until the annual stalks are withered: the best and soundest roots being selected for white ginger, they are scraped clean and dried carefully in the sun; but the others are merely scalded and then dried. When a preserve is to be made of the root-stocks, they are dug up whilst in sap, the stalks not being then more than five or six inches long. For this purpose, the young roots are scalded, then washed in cold water, and afterwards carefully peeled. They are then soaked for three or four days, during which the water is frequently changed; and being subsequently put into jars, a weak syrup is poured over them, which is afterwards exchanged for a stronger one, and so on for two or three times. The manner of cultivating ginger is extremely simple, requiring little care; it is propagated with as much ease, and nearly in the same manner, as potatoes are in Great Britain. Other species of this tribe are valued for their spicy qualities; such is the Turmeric Plant, formerly mentioned as yielding a beautiful yellow dye (397), of which the powdered root-stock is one of the constant ingredients with ginger, cardamoms, and other spices, in the celebrated curry-powders of the East Indies. The seeds also of some species, as the Cardamom, are aromatic, and are employed in medicine as cordials. The rhizoma of almost every plant in this order contains a large quantity of starch, which might be employed in the same manner as Arrow-root; but it is difficult to separate this in such a manner, as to free it from the pungent and resinous secretions with which it is intermixed.

700. The order MARANTACEÆ or Arrow-root tribe is so nearly allied to Scitamineæ, that some Botanists have associated them.

They are, however, distinguished by a variation in the position of the fertile stamen in the flower,—a character, which, as it is constant, is of great botanical importance, although apparently trifling; and there is also a difference in the structure of the seed. The properties also of the two orders are very distinct; for whilst, in the former, the secretions have universally a pungent stimulating character, they are destitute of any peculiarity in the present one; so that the large quantity of fecula contained in their rhizomas may be separated in a very pure state. The plant from which Arrow-root is ordinarily derived is a native of South America; but it is now much cultivated in the West Indies, and in some parts of Hindostan. It rises to the height of two or three feet, has broad pointed leaves, and is crowned by a spike of small white flowers. Other species have more showy flowers; such is the *Canna*, sometimes cultivated in our hot-houses, the seeds of which are so hard as to have received the name of Indian Shot.

701. There are probably no Vegetable products that serve as articles of food to man, which are produced in such large quantity, with so trifling an amount of care and attention, as those afforded by one or two species of the order MUSACEÆ, or *Plantain* tribe. All the plants of this group are, like those of the two former, natives of tropical countries; the *Plantain* itself is not at present known except under cultivation, and being now almost universally diffused through the warmer regions of the globe, it is difficult to state what is its original habitation. The leaves of the whole of the order are characterized by the peculiarity in the distribution of the veins formerly mentioned (§ 231) as existing in the Plantain and Banana. In the structure of their flowers, we find a still nearer approach to the regular type. These arise in clusters, protected by a large bract enfolding many buds, which is termed a *spathe*. The perianth consists of six pieces, all of which are frequently of brilliant colours; but as three are generally external to the others, they must be regarded as sepals of the calyx, whilst the inner ones constitute the corolla. They are all adherent at the bottom to the ovarium, which is consequently

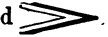
inferior; and they sometimes present a degree of irregularity. The stamens are six in number, but some are not unfrequently undeveloped; the anthers in many species are surmounted by a sort of crest resembling an expanded petal. The ovarium consists of three adherent carpels, which form distinct cells, each generally containing several seeds; the styles are united into a single column; but this separates at the top into three stigmas. The fruit is usually succulent.

702. The two most valuable plants of this order are the Banana and Plantain; the fruit is nearly the same in form and size, but differs in taste; that of the former being sweet, somewhat resembling a high-flavoured but over-ripe pear: whilst that of the latter is nearly insipid. Their other differences, however, are trifling; and many Botanists consider that, as they are only known in cultivation, they are not unlikely to be varieties of the same species. They are most splendid plants, the stems formed by the cohesion of the leaf-stalks varying from ten to twenty or even thirty feet in height, and the leaves themselves being three, four, or even ten or twelve feet in length. The rapidity of their growth is most extraordinary. They are propagated by the separation of buds or suckers; eight or nine months after these have been planted, they begin to form their clusters; and the fruit may be collected in the tenth and eleventh months. When a stalk, on which the fruit has ripened, is cut, a sprout is put forth, which again bears fruit in three months. A cluster of bananas, produced on a single plant, often contains from 160 to 180 fruits, and weighs from 70 to 80 ℔s. A spot of little more than a thousand square feet will contain from thirty to forty Banana plants; and it is reckoned that from this number, in full growth, at least 4000 ℔s of fruit may be annually obtained. Humboldt has calculated that, from the same extent of ground, only about 33 ℔s of wheat or 99 ℔s of potatoes could be raised; so that the Banana appears to be 133 times more productive than the first, and 44 times more than the second. But this is not altogether true; since, weight for weight, the nutritive matter of the Banana cannot be compared with that of wheat or even of potatoes. Still, a much greater

number of individuals may be supported upon the produce of a piece of ground planted with Bananas, compared with a piece of the same size in Europe growing wheat; Humboldt estimates the proportion as twenty-five to one.

703. The Banana flowers and bears fruit through the whole year, so that a constant supply is afforded by such a plantation as that with which the natives of the countries where it flourishes surround their habitations. The labour of cultivating this is very slight; all that is necessary being to cut the stalks that are laden with ripe fruit, and to turn up the earth round the roots about twice a year. When families settle, the first step towards their support is to establish a Banana walk; which, from the rapidity with which the plant grows, is soon accomplished; and this is afterwards extended as occasion may require. Humboldt remarks that a European traveller, newly arrived in the torrid zone, is struck with nothing so much as the extreme smallness of the spots under cultivation round a cabin which contains a numerous family of Indians. Three dozen good-sized fruits are sufficient to support a man entirely for a week. They are not only eaten fresh, but are dried, like figs, in the sun; and a sort of meal may be extracted from them, by cutting them in slices, drying them in the sun, and then pounding them. It has been well remarked that "the facility with which the Banana can be cultivated has doubtless contributed to arrest the progress of improvement in tropical regions. Necessity awakens industry, and industry calls forth the intellectual powers of the human race. When these are developed, man does not sit in a cabin, gathering the fruits of his little patch of Bananas, asking no greater luxuries, and proposing no higher ends of life, than to eat and to sleep. He subdues to his use all the treasures of the earth by his labour and his skill; and he carries his industry forward to its utmost limits, by the consideration that he has active duties to perform. The idleness of the poor Indian keeps him, where he has been for ages, little elevated above the inferior animal; the industry of the European, under his colder skies, and with a less fertile soil, has surrounded him with all the blessings of society,—its comforts, its affections, its virtues, and its intellectual riches."

704. The supply of food derived from the Plantain and Banana is not the only benefit afforded to man by the order Musaceæ. The gigantic leaves of other species are used for thatching Indian cottages, for a natural cloth from which the traveller may eat his food, and as a material for basket-making; and one species yields a most valuable flax, from which some of the finest muslins of India are manufactured. The stems of most of them, consisting as they do of the united petioles of the leaves, are remarkable for the very large quantity of spiral vessels they contain, which may be pulled out in handfuls; these are collected in the West Indies, and used as tinder. The juice of the fruit of one species is employed as a dye.

705. The next order, Iridaceæ, or *Iris* tribe, is well known in this country by the wild species, commonly termed *Corn-flags*, which abound in moist and shady places, and by the more showy kinds introduced from abroad, which are now among our commonest garden plants. The order is characterised by the peculiar arrangement of the leaves, which are said to be *equitant*. If we pull one from its origin, we shall find that what appears to be a flat expanded leaf does in reality expose but half its surface, the leaf being folded together, so that its under side is entirely concealed. These folds are adherent together at their upper part; but at the lower they are commonly separated by a new leaf which may be thus represented . It is from the resemblance between the position of the external leaf and that of the legs of a man on horse-back, that it is said to be *equitant* or riding. These leaves may probably be considered as in reality very large bracts, the true leaves being undeveloped; for the flower-stalks rise from between their folds, just as they do from within the sheathing bracts of Musaceæ, &c. In the Iris, the external whorl of the flower, as well as its interior, is brightly coloured; but this is not universal in the order. The three sepals are broad and spreading, and are often ornamented with a beautiful feathered crest; the three petals stand erect, and curve over the centre of the flower; and the stigmas are broad richly-coloured parts, resembling petals, and spreading away from the centre. At first sight it might be

thought that the Iris is almost destitute of stamens; but if the stigmas be lifted up, these will be found hidden beneath their broad lobes; they are three in number, and are remarkable for the peculiar position of the anthers, which have their faces (the side on which they open) turned towards the sepals, instead of towards the style The carpels also are three in number, and adhere together so as to form a three-celled ovarium, the partitions remaining distinct; but the styles coalesce into a single column. In the *Crocus*, however, of which the common garden species is so cheerful an indicator of departing winter, there are some important differences of structure. The stigmas do not expand, but are rolled up; still they are very large, and seem too heavy for the style, so that in the Saffron Crocus they hang down on the outside of the flower, like an orange-coloured tassel. The leaves, too, in the Crocus, are not equitant; so that this species departs widely from the general character of the group, and in fact connects it with the Amaryllis tribe. The growth of the leaves and flowers in the Iris takes place from a horizontal stem or rhizoma, which is not subterranean, but prostrate on the surface of the soil; and each successive yearly growth, instead of dying away as in other instances, continues in connexion with the foregoing; so that a mass of stem, bearing apparently distinct plants, is sometimes produced to a considerable extent, and is sometimes prolonged into branches by the development of lateral buds. In the Crocus, however, we find the leaves and flowers springing from a solid bulb, which must be regarded as a contracted stem; this neither lengthens upwards or downwards to any considerable extent; but the buds formed from it separate (as in the Orchis), and the old bulb perishes.

706. The plants of this order are principally natives of the middle parts of North America and Europe, and of the Cape of Good Hope. They do not extend, to any great amount, between the tropics; nor into the colder parts of the temperate zone. The very numerous species belonging to it spring up at the Cape of Good Hope, upon the commencement of the rains; and soon cover the parched and bare-looking plains, with a robe of the deepest green, adorned with all shades of gay and sparkling

colours. They are more remarkable for their beautiful fugitive flowers than for their utility. The chief product they afford is Saffron, the uses of which have been already described (§ 397). The rhizoma generally contains nutritious matter combined with slightly aromatic secretions; this is used as food in some places where Irises abound; and that of the Iris Florentina, from its agreeable odour, is employed under the name of *Orris root*, as an ingredient in tooth and hair powder. In a few species the rhizoma contains an acrid bitter principle, which has occasioned it to be employed with effect as an emetic and purgative.

707. Another very beautiful tribe of plants, for the most part inhabiting the same localities, is that of AMARYLLIDEÆ, the *Narcissus* tribe, of which the common Daffodil and Snowdrop of this country are examples. This is nearly allied to the last order, in the possession of a three-celled inferior ovarium, a single style, and a three-parted stigma; but the stamens are here six in number, and their faces are turned, in the usual manner, towards the style. This is a very important character, for it is constant throughout the order; whilst the opposite position is equally characteristic of the Irideæ, serving to distinguish those members of each which are otherwise most nearly allied. The perianth consists of six portions, amongst which there is little difference in form or colour: but as they form two whorls, the outer one must be regarded in the light of a calyx. There is often, however, a departure from the regular form, in the partial development only of some of these. Thus in the Snow-drop the interior whorl is very small, and is almost contracted into the little fleshy bodies which are sometimes called nectaries. In the Narcissus, again, besides the two whorls of the perianth, there is a sort of fleshy cup or nectary, which is shown to be formed of the rudiments of an additional whorl, by being sometimes converted into an outer row of stamens, and sometimes into an inner set of petals,—a metamorphosis, which, in an allied genus is constant. The plants of this order generally arise from a *scaly bulb*, which consists of a shortened expanded stem, surrounded by fleshy colourless leaves (§ 149), the true roots originating from its base; sometimes, how-

ever, the axis separates at once into roots, without this expansion. The leaves are usually sword-shaped, with veins running nearly parallel from one extremity to the other.

708. It is interesting to remark that, whilst the external characters of the last two orders are so nearly the same, the minute differences which have been mentioned,—the number of the stamens and the positions of the anthers,—should indicate most important variations in their properties. For, whilst nearly all the Irideæ are harmless, and some are nutritious, the Narcissus tribe are characterized by their poisonous properties. These are principally apparent in the viscid juice of the bulbs of African species of Hæmanthus, into which the Hottentots are said to dip their arrows in order to render them venomous; but they have long been known in other kinds. The narcotic odour of the common Narcissus was known to the ancients; as was also the emetic principle contained in its bulbs, which is at the present time sometimes employed in medicine. Its juices appear to combine narcotic and acrid properties, which are so powerful, that two or three drachms of the extract will destroy life in the course of a few hours. Many of the species of the genus *Amaryllis*, which is especially abundant in South America, are distinguished for the fragrance of their flowers; this is much diminished, however, by the effects of cultivation, which causes the flower to become double. One species is cultivated for the sake of its roots, especially in Peru, where they are eaten as potatoes are in this country.

Order LILIACEÆ, or Lily tribe.

709. The species associated by De Candolle under this order may be advantageously separated, on account of their number, and their differences of structure, into three subordinate groups, the *Asphodel* tribe, the true *Lily* tribe, and the *Bromeliaceæ* or Pine-Apple tribe. The *Asphodel* tribe includes the Hyacinth, Onion, Squill, &c. and is remarkable for the extreme simplicity of the structure of all its parts, and for the strong similarity which exists in the flowers of the different species. They have all a perianth consisting

of six pieces of similar form, size and colour, arranged in two rows,—the outer one, therefore, being calyx, and the inner one corolla. Within the latter are six stamens; and in the centre is a *superior* three-celled ovarium, which changes to a fruit containing many seeds, covered with a black brittle skin. The majority of the plants so characterized are quite harmless, and remarkable either for their use or their beauty. Their stems arise from scaly bulbs, from the bottom of which the roots are developed. These bulbs (and others similar to them) may be regarded as buds, in which the leaves are thick and fleshy, including a store of nutriment for the young plant, and the development of which may be delayed (as in seeds) for an indefinite time, without the loss of their vitality. This is a beautiful adaptation to the circumstances in which these plants are formed to grow; for they are naturally inhabitants of places which at certain seasons of the year are quite dried up, and where all vegetation would perish, if it were not for some such provision as we find in the bulb. In places like the hard dry karroos of the Cape of Good Hope, where rain falls only during three months in the year,—or the parched plains of Barbary, where the ground is rarely refreshed by showers except in the winter months,—and on the burning shores of tropical India, beyond the reach of the tide, and buried in sand, the temperature of which often rises to 180°,—bulbous-rooted plants are thus enabled to live, and to enliven such scenes with their periodical beauty.

710. Although, however, the bulbous structure, and herbaceous vegetation, are very common among the Asphodel tribe, they are not universal; for many plants have little or no trace of bulbs; and some species, especially between the tropics, attain considerable size and age as trees. The most gigantic of the order is the Dracæna Draco of the Canary islands, from which the resinous colouring material named Dragon's Blood is derived; one of these has been stated to be between 70 and 75 feet high, and 46½ feet in circumference at the base, and to have been a very ancient tree in the year 1496. The principal differences in the structure of the familiar plants of our own climate, are to be found

in the varieties of degree in which the parts of the calyx and corolla are united to each other, and in the formation of a stem covered with leaves, the first rudiment of the aborescent stems and branches of the tropical species. In the *Onion*, for example, all the parts of the perianth are distinct; but in the wild blue Hyacinth, or *Blue-Bell* (as it is more commonly termed) they cohere nearly to their points; and in another genus they are completely glued together. Again, in the *Asparagus*, the stem, when full grown, is repeatedly branched, and covered with little taper leaves, so as almost to resemble a Dracæna in miniature. Throughout this order, the leaves are long and narrow, like green straps, with simple parallel veins, sometimes much resembling those of Grasses.

711. Many of the plants of this order are great favourites in gardens on account of their showy flowers; and of the foreign species, several are easily naturalized in this country. Such are the *Asphodels* themselves, which are not natives of Britain, but which have long been ornaments of our gardens. The bulbs generally contain a large quantity of fecula, which is usually mixed, however, with a peculiar secretion that imparts to it a strong and frequently unpleasant taste, together with powerful medicinal properties. In the Onion, Garlick, Shallot, and other plants belonging to the genus *Allium*, the taste is such as to render them valuable to give flavour to other articles of food, whilst the more active principle is only present in small quantities; and many of these, when the quantity of fecula is increased by cultivation (which does not increase the amount of peculiar secretions in the same degree) are themselves employed as articles of food, especially when their taste is rendered less strong and acrid by the heat employed in their preparation, or by the warmth of the climate in which they grow. Garlick and onions have been esteemed in Egypt from very early times; and the account of the traveller Hasselquist shows, that there is good reason for the superior value there set on them. "Whoever," he says, "has tasted onions in Egypt will allow that none better can be had in any part of the universe. Here they are sweet, in other countries they are nauseous and

strong; here they are soft, whereas in the northern and other parts they are hard, and their coats are so compact that they are difficult of digestion. Hence they cannot in any place be eaten with less prejudice and more satisfaction than in Egypt." The onions of Spain and Portugal, and even those of the South of France, are for the same reason very superior to the common onion of our gardens, being of a much larger size, and more mild and succulent; yet the latter is looked upon, by the rustic inhabitant of many parts of Britain, as his chief vegetable dainty; and the garlick, which is too strong for most people in this country, is equally relished by the poorer classes on the continent as an adjunct to their black bread, and even by the rich as an ingredient in their dishes.

712. The common Hyacinth deserves especial mention on account of the interest taken in it for the sake of its beautiful flowers, and the numberless varieties of these which cultivation has induced, rather than for any particular service of which it is capable. The Dutch florists, who have particularly attended to this tribe, had at one time upwards of two thousand varieties of one species; and although the *mania* for speculating in Hyacinth and Tulip bulbs has now long since passed, these still form a branch of Dutch commerce by no means unimportant. The Squill bulb, preparations of which are much employed in medicine as emetics, expectorants, &c, is acrid, bitter, and nauseous to the taste; it is a native of the South of Europe, growing freely on the sandy shores of Spain, Italy, and Greece; it sometimes attains the size of a man's head. The Asphodels also contain a bitter principle, which is removed, however, by boiling; one species which covers immense tracts of land in Apulia, affords abundance of nutritious fodder for sheep; and pigs are said to be so fond of the bulbs, that they will unearth the roots to devour them.

713. One of the most interesting tribes belonging to this extensive group, is that of the *Aloe* and its near allies, most of which are highly ornamental plants, whilst some afford a very serviceable drug, and others supply products capable of being applied to many important uses. They are remarkable for the large

size of the leaves, which are thick and fleshy, and which sometimes attain the length of eight feet or even more; each terminates in a hard sharp point, about half or three-quarters of an inch in length, and in appearance not unlike the claw of a beast of prey; so that a hedge or fence made of a series of these plants is quite impenetrable to cattle, and almost so (in consequence of the great toughness of the leaves) even to man, unless well provided with cutting instruments. The proper juice of the Aloe is very bitter and stimulating; and the extract made from it is much used in medicine as a purgative. The species which yields it in the largest quantity, and in the most active form, is cultivated at the Cape of Good Hope, whence large quantities of it are imported into this country; the drug is also obtained from several species that grow in Barbadoes, but this is less pure than the other, and is principally used in this country by farriers, &c.

714. Nearly allied to the Aloe is the *Phormium tenax*, the plant which yields the (so-called) New Zealand Flax; the fibres of which are very much stronger than those of hemp, whilst they may also be prepared in such a manner as to become beautifully white and lustrous, like silk. Many attempts have been made to propagate this valuable plant, both in Britain and in Australia; as yet, however, these have not been attended with any great success. Still it is imagined, that, if its cultivation were extended to a considerable amount in its native clime, the New Zealand Flax might be introduced into this country at a price far below that of Hemp and Flax, whilst superior to them in quality

715. The points in which the plants of the true *Lily* tribe differ from Asphodels are not striking or numerous. The leaves are similar, being narrow and strap-shaped, with simple parallel veins; and these, together with the flower-stalks, shoot up from underground bulbs. Moreover, if the flower of the Tulip or Lily be examined, it will be found to consist of six leafy portions, similar in colour, size, and form, and differing only in position, just as in the Onion tribe. Further, these envelope six stamens, within which is a three-celled ovarium, containing a number of

ovules in each cell. The two groups, however, are more different in their general characters than their agreement in these particulars would lead us to suppose. The Lily tribe are remarkable for their greater general development, and the far superior size of their flowers: this becomes apparent, when we compare Asphodels and Hyacinths, pretty as they are, with Tulips, Lilies, Crown Imperials, &c. The particular character by which they can be best distinguished, is derived from the nature of their seeds; which instead of having in the Liliaceæ, as in the Asphodeleæ, a hard black brittle coat, has a soft pale spongy integument. Moreover, they attain their greatest development in the warmer parts of the temperate zone, rather than in the equinoctial region. Their juices, too, are much less impregnated with peculiar secretions; so that the bulbs are more edible. Some of them are cultivated abroad as the potato is here, especially in Siberia; in this country they are generally used for emollient poultices. The scent of the Lily is so powerful that it distresses many persons to have the flowers near them, especially in a room; but that of a species cultivated under the name of the Tuberose is much more powerful, especially in the evening. This is one of the flowers that has been seen to emit electric sparks, which are supposed to be of electric origin. The Tulip, on the other hand, is a scentless though a very showy flower. It has been chiefly rendered famous by the commercial gambling of the Dutch, a century or two ago. To such an excess were fictitious speculations carried, that the madness of the period was not unaptly termed Tulipomania. Single bulbs were bargained for, to be bought or sold, for upwards of £500 apiece.

716. The subdivision of *Bromeliaceæ*, or the Pine-Apple tribe, is separated by some Botanists to a considerable distance from the others, on account of the hard dry character of the leaves, and the firm herbaceous structure of the calyx, the sepals of which are not coloured as in the previous tribe. The most characteristic species is the Pine-Apple, which is believed to have been originally confined to the New World, and to have been propagated thence, by the early discoverers, to those parts of Asia and Africa in which

it has been subsequently found apparently growing wild. It is not known to have been cultivated in England until the end of the 17th century; but at the present time, the skill and attention of British gardeners have rendered the fruit grown in this country more prized for flavour and elegance than that produced in its native climates. Great expense, however, is incurred for this purpose; so that a Pine which might be bought for six-pence in a West Indian market costs the English grower almost as many pounds. This is very different from ordinary fruits, consisting of a large number of ovaria with their perianths grown together and become succulent, somewhat as in the Bread-fruit (§ 673).

717. To this tribe properly belongs the *Agave* or American Aloe, which, from its strong general resemblance, is commonly associated with the true Aloe. Its various species were originally natives of tropical regions, where alone they attain their proper size; but they have been introduced into the South of Europe, where they will grow wild in the open air. The leaves have very much the character of those of the Aloe; and from the midst of them is sent up at long intervals a tall and elegant flowering stem, which attains a height of from 20 to 40 feet, growing very rapidly when once its development begins. This rarely takes place, however; the times of flowering in Mexico are from eight to eighteen years apart; and in the specimens grown in this country, the interval is so much prolonged as to be commonly reputed a hundred years. The fibres which may be obtained from the long straight veins of the leaves of the Agave are very strong, and may be employed for various useful purposes. They are tougher but less elastic than those of hemp; and being very durable, they are of great utility to the inhabitants of the countries where these plants abound. When the hard point is forcibly separated from the leaf, especially after this has been soaked in water, it draws with it a bundle of these fibres; and these may be employed as coarse thread, whilst the point itself is used as a needle; whence this natural product has been called "Adam's needle and thread." The fibres are employed in Mexico to make

a strong twine, of which are composed the ropes that are commonly used there in the mines; and on the Western coast of that part of America, rigging for ships is made of them. The Mexicans cultivate it largely, however, for another purpose. When the Agave has arrived at maturity, a spirituous liquor is obtained by tapping the stem, which is a favourite beverage of the lower classes, under the name of Pulque. A good plant yields from eight to fifteen pints of pulque per day, during two or even three months; and the large quantity consumed may be judged of from the fact that, before the Revolution, a very small municipal duty exacted at the gates of the two large towns, Mexico and La Puebla, upon the pulque brought into them, amounted to about £170,000 sterling a year. Several species of Aloe are capable of affording very strong and valuable fibres; and among these is one known in the West Indies under the name of the silk-grass-plant, the fibres of which are so extremely like those of white silk, that the importation of them into some countries is forbidden, in order to prevent imposition.

718. Nearly allied to the Lily tribe is one of which the members are as distinguished for their poisonous properties, as for the beauty of their flowers. This is the COLCHICACEÆ or Meadow Saffron tribe, the flower of which, like the Lilies, has a double perianth, all whose parts are alike in form, size, and colour; it has also six stamens, and a superior three-celled ovarium. The Colchicum (Meadow Saffron) itself is very like a Crocus in its flower; but its superior ovarium prevents it from being confounded with the tribe to which that belongs. Other species approach very closely in general aspect to the Asphodeleæ; but they may be easily distinguished by three marks. In the first place they have no bulbs, but a solid knob or swollen under-ground stem, like that of the Crocus; secondly, the face of the anthers is turned, as in the Irideæ, to the outer side of the flower; and thirdly, the styles of the several carpels remain distinct, so that there are three instead of one. The Meadow Saffron is remarkable for the singular form of its flower, and for the mode in which it is connected with the bulb: the portions

of the perianth are united so as to form a tube, and this is immensely prolonged (sometimes to the extent of 8 or 10 inches) shooting up directly from the tuber, without being supported by a flower-stalk. As the ovarium lies near the bottom of this tube, whilst the stamens are situated in the expanded part of the flower, the styles are necessarily very long; and the performance of their peculiar function under such circumstances is extremely curious. The Meadow Saffron of this country is termed *Colchicum autumnale*, from its peculiar season of flowering, which is in September or October. The flowers are large, and of pale purple; they spring up without leaves, forcing themselves through the soil, and expanding just above the surface. They then wither away; but the seed-vessel, being then scarcely elevated above the bulb, is protected beneath the ground during the winter. In spring, the leaves are put forth, and they carry up with them the seed-capsules, which then ripen. The bulb, however, is at this time exhausted; and a new one is formed at its base, from which the flowers of the next season are

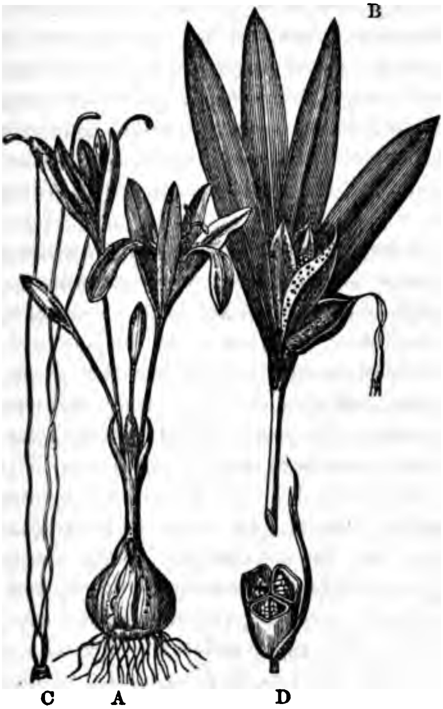


Fig. 111. Colchicum Autumnale. A, bulb with flowers; B, bunch of leaves and capsules; C, ovarium and styles; D, seed-vessel cut across.

developed. These bulbs contain (as in other instances) a large quantity of starch; and this, if freed from their peculiar secretions, is highly nutritious. But the juices are very acrid and powerfully irritating; so that the bulbs of most of the species, especially the Colchicum and Veratrum (commonly called White Hellebore) are of a very poisonous character. Their properties are such, however, as to render them very useful when properly administered as medicines; and these they possess in the greatest intensity about June or July; at which time, therefore, the bulbs should be gathered. The active principle exists also in the seed-coats, from which it may be extracted by spirit of wine. It is said that the bulbs of some species of Colchicaceæ are eaten, without injurious effects, in the south of Europe. The order is pretty widely distributed over the globe, but especially abounds in the northern hemisphere.

719. The order Juncaceæ, or *Rush* tribe, has apparently but little relation with the tribes last described; yet if its structure be closely examined, it will be found to be similar in all essential particulars with that of the Lilies, Asphodels, and Meadow Saffron. Many of the commonest Rushes are humble leafless plants, with stiff slender wiry stems, and little clusters of dingy flowers; others are still smaller in stature, but possess distinct leaves. These are usually long and narrow, resembling those of the Grasses. The structure of the flowers can scarcely be made out, except by the aid of a magnifying glass and a strong light, on account of their minuteness and dull colour, and also through their being closely packed in clusters. When carefully examined, however, each flower will be found to possess a spreading perianth of six pieces, of which three external form the calyx, and three internal the corolla; on the outside of these are two or three bracts, so like them as scarcely to be distinguished from them, except by their position. From within the flower arise six (sometimes only three) stamens; and in the centre of the latter is the superior ovarium, which has three angles, indicating its formation from three carpels, and also three stigmas; but the style is single. In the two Rushes, the ovarium has three cells; but in some other species it

is one-celled, from the absence of the partitions; the placenta is central, and commonly bears three ovules. The seed-vessel often contains but one seed, the rest of the ovules being undeveloped; the seeds are enveloped in a pale soft skin. Now it will be observed that there is very little essential difference between the flowers of the true Rushes, and those of the Lilies and Asphodels, the number and arrangement of the Sepals, Petals, Stamens, and Carpels, being in all the same. The difference chiefly consists in the *degree* of development of the calyx and corolla, which is greatest in the Lilies, less in the Asphodels, and least of all in the Rushes, which may be regarded as the lowest of the Endogenous tribes whose flowers are constructed upon a regular plan.

720. The Juncaceæ are chiefly found in the colder parts of the world, and even in the coldest, two being natives of the ungenial climate of Melville Island. From the absence of higher orders of plants in such countries, Rushes form a large part of their whole vegetation; thus in arctic regions they are estimated at $\frac{1}{25}$, whilst in temperate latitudes they are but $\frac{1}{90}$, and in tropical countries $\frac{1}{400}$. The uses to which they are applied by man are few. They are employed, as are also other plants belonging to the *Sedge* tribe (§ 733), for making chair-bottoms, baskets, mats, &c.; and before carpets came into general use, the floors even of palaces were strewed with them. It is on record that one of the charges of extravagance brought against Cardinal Wolsey was, that his room was strewed with fresh rushes as often as once a week. The cellular tissue filling the interior of the stems of Rushes, which has very much the appearance of pith, is in great request, in country places, to form the wicks of candles, hence called rush-lights. The Juncaceæ usually grow from a rhizoma, which is often itself branching, and which sends out long spreading roots. Hence they are employed, with other plants of a similar character, to strengthen embankments raised to keep out water from low lands, by binding together the soil of which they are composed; it is in Holland that they are of the greatest service for this purpose.

Order PALMACEÆ, or Palm Tribe.

721. Palms were called by Linnæus the Princes of the Vegetable kingdom; whilst to Lilies he assigned the designation of Patricians or Nobles. The Palms exceed most other plants in size, and surpass them all in grandeur and majesty of aspect. They naturally, therefore, commanded the earliest attention of mankind; and the innumerable purposes to which their fruit, their leaves, and their stems have been applied as food, clothing, and shelter, have worthily retained for them that regard which their beauty at first excited. They all bear a strong general resemblance to each other, and hence were early distinguished by a peculiar name. They are mostly remarkable for the size and strength of their stems, which usually shoot up to a great height from the ground, tapering gracefully from the base to the summit, and surmounted with a magnificent crown of gigantic leaves. These towering stems (which, when growing in sheltered situations, are often perfectly straight) sometimes attain the height of 200 feet or even more. Other species, however, have stems which trail along the

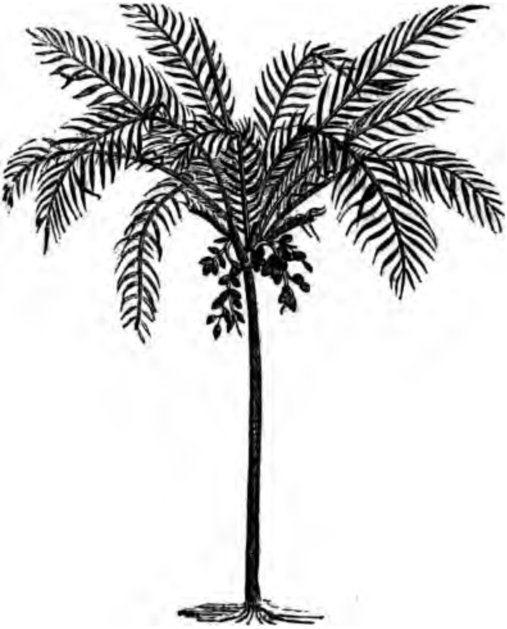


Fig. 112. Cocoa Nut Palm.

ground; and these extend to the length of 500 feet; such is the common Cane, which differs from the Bamboos and other *Canes* properly so called (which belong to the Grass tribe) in having a solid instead of a hollow stem. Although the trunk usually sends out no branches, it occasionally subdivides into two, and these again separate, as in the Doum Palm of Egypt. The Palms are remarkable for the prodigious development of their organs of fructification. A single bunch of the staminiferous flowers of the Date contains about 12,000; whilst another species has been estimated to bear above 200,000 in one cluster, and three times that number on each individual.

722. Although the flowers are frequently complete,—each containing both stamens and pistils,—they are more frequently polygamous, that is, both complete and incomplete flowers are borne on the same individual. They are crowded together in large clusters upon a stalk which is termed a *spadix*, having an enormous bract developed from its base, termed the *spathe*, which enwraps them all. The perianth consists of six pieces, in two series, forming therefore a calyx and corolla; the outer whorl is often the smaller. The stamens are commonly six in number, sometimes however only three, and occasionally indefinite. The ovary is superior, generally divided into three cells, of which each contains a seed; the styles and stigmas of the three carpels are more or less adherent. In the ripe fruit, however, it is commonly found that the seed of only one cell has been developed;

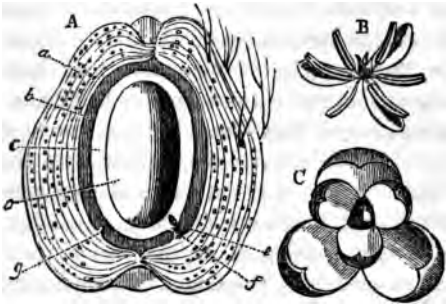


Fig. 113. Flowers and fruit of Cocoa Nut Palm. B, staminiferous flower. C, pistilliferous flower. A, section of fruit; *a*, husk, or pericarp; *b*, shell or endocarp; *c*, albumen; *d*, cavity within it; *e*, embryo; *f*, aperture of shell; *g*, rudiment of other aperture.

and that the other cells are therefore obliterated. In the common Cocoa-nut we have an example of this; the fruit, when covered with the husk, is evidently three-lobed; and when the husk is detached from the shell, the latter exhibits three spots upon its rounded end, of which two are hard, whilst the other is soft and easily perforated. The fibrous husk is the outer wall of the ovarium; the shell is the inner wall, with which the seed is in close contact. If the Cocoa-nut be cut through lengthways, by a section passing through the middle of the soft spot, it will be found that the small embryo is situated just beneath it, lying in the midst of the firm fleshy albumen; and we understand, therefore, that the two hard spots indicate the positions of the two embryos which have not been developed. In the Date-Palms, the staminiferous and pistilliferous flowers grow on separate trees; and the fertilization of the latter is dependent upon the conveyance of the pollen from the former, which is usually accomplished by the agency of the wind, of insects, &c. But if unseasonable weather, or any accident should prevent this, the Date crops entirely fail, or the fruit is degenerate and unfit for food. In order to prevent such an occurrence, the Arabs, many tribes of whom rely almost entirely on this tree for their supplies of food, have long been accustomed to gather the stamineous clusters, and to hang them over the pistilline flowers; and they even lay up stores of pollen from year to year. When they make inroads into the districts inhabited by hostile tribes, they cut down the stamen-bearing palms, as one of the most severe injuries they can inflict. It is on record that the threat of doing so, on the part of those attacked, once warded off an invasion. The Grand Seignor having meditated an invasion of the city and territory of Bassora, the prince of that country prevented it, by giving out that he would destroy all these palms on the first approach of the enemy, and by that means cut off all supplies of food from them during the siege. The facts that had been well ascertained by the experience of ages respecting the Date-Palm, were very important to Linnæus, in supporting the doctrine of the relative functions of the stamens and pistil, of which he was the first to give a correct exposition;

for although this is now universally admitted to be correct, it was at first, like other novel doctrines, most vigorously opposed by many.

723. The Stems of Palms are the best of all examples of Endogenous structure. They are frequently so dense externally, as to bear the stroke of a sharp hatchet without injury. This is caused by the very close interweaving of the woody bundles that descend from the leaves, with those previously forming the exterior; for although they at first pass down through the soft centre of the stem, they direct themselves outwards near its bottom, and penetrate like roots into the exterior mass of fibres already thickly interwoven. In most of the species with long slender trailing stems, the exterior is additionally hardened by a copious deposition of silex, as in the Grasses; this is especially the case in the Rattan, which will readily strike fire with steel.

724. Palms are exclusively confined to the regions bordering on the tropics in both hemispheres. They scarcely range beyond 40° north and south of the equator; but particular species are found somewhat beyond these limits. Their chief habitation is South America, where they mostly abound in the low and humid parts of the country, though some species rise upon the sides of mountains, almost to the limits of perpetual snow. In general each species is confined within very narrow limits; it is related by Humboldt, that in travelling through the central part of South America, he found a new species at almost every fifty miles. Although nearly two-thirds of the Palms at present known are natives of South America, none have yet been found in South Africa, where the distance from the Equator is the same. Some species, however, appear to be very easily spread by the agency of man, or by natural causes; and this, by the kind provision of a beneficent Creator, is especially the case in regard to those which are most capable of being made useful to him. The Cocoa-nut, for example, is found in almost all the islands of the Polynesian Archipelago; even in those as yet untenanted by man, which have been upraised by the agency of minute coral-building polypes, from the depths of the sea. This is easily accounted for, when it

is considered that the Cocoa-nut may float a long time in the sea, without the seed receiving any injury, in consequence of its protection by the fibrous husk and dense shell; but when cast up by currents of the ocean on the low shores of these islands, the husk gradually separates, under the combined influence of the sun, air, and occasional moisture, and allows the seed to be acted on by those influences which will excite it to germination. The Cocoa-nut, like other species which are capable of living in a variety of conditions, has a great tendency to run into subordinate varieties; and as many as thirty of these are sometimes known to the natives of a single island, whose attention is called to them by the important benefits they derive from them, and who distinguish them by different names. The same is the case, in a less degree, with the Date Palm, and with other species.

725. It would be impossible here to enumerate all the uses to which the various parts of these important trees, and heir products, are applied, by the inhabitants of the countries where they abound; since these include almost every one for which all other tribes of the Vegetable Kingdom are employed by those that respectively possess them. Wine, oil, wax, flour, sugar, salt, says the celebrated traveller Humboldt, are the produce of this tribe; whilst their own fabric affords the materials of the habitations, vessels, weapons, and clothing, of many nations. A few, only, of the more remarkable of these uses can here be adverted to. The exterior of the stems, of most species, affords a wood which is extremely valuable for its hardness, sometimes even taking a very high polish; in many countries, this is the only kind of timber which the inhabitants possess; and it must therefore serve all the purposes for which wood is required. Of the hardest parts, weapons are usually manufactured; and these possess such density, as to be no unfit match for those of iron. Sections of the stem, the soft interior being removed, are converted into drums; and the stems, split lengthways, and channeled out, are employed as conduits for water. The soft interior, in most of the large-stemmed species of the Palm tribe, resembles the pith of Exogens in its freedom from woody bundles, consisting entirely

of cellular tissue; and it usually contains a large quantity of starch, which renders it very nutritious. This is obtained as food from many species, but especially from what is called the Sago Palm, in which it is particularly abundant. The unexpanded buds also, at the extremity of the stems of many species, furnish a wholesome article of food this is especially the case in a species known in the West Indies by the name of the Cabbage-Palm, from the similarity in flavour between its buds, when boiled, and ordinary Cabbage. This palm, when growing by itself in favourable situations, is one of the stateliest and most elegant of the whole race; the author has himself seen one in the island of St. Vincent, the height of which was said to be above 200 feet. But when growing in thick woods, which prevent the full influence of the sun upon its bud, the stem is dwarfed; and it is then not unfrequently cut down for the sake of the product just named. At the base of each leaf of many Palms, there is a sort of sheath composed of a fibrous network, which is probably a modification of a stipule; this is used by the Indians to form cradles, and also a sort of coarse cloth. The leaves are used entire to form thatch, fences, and fuel; the midribs furnish oars; and the fibres of the leaves, like those of the husk of the Cocoa-nut, are spun into thread, from which cords, cables, and woven fabrics of various degrees of fineness are manufactured. The rope made from the fibres of the Cocoa-nut husk, which is known under the name of Coir-rope, is nearly equal in strength to hemp, and is considered superior to it for cables on account of its great elasticity. The sap of the Palms, which flows in great abundance from the spathes when wounded, is a very pleasing beverage, and contains a considerable quantity of sugar; this may be separated by boiling it down; or it may be converted by fermentation into alcohol so as to make a sort of wine (the Palm Wine of Africa), or to afford the material for distilling spirit (the genuine Arrack of India). Many of the Palms furnish a fruit which is wholesome and palatable, as well as of great value, from the large amount in which it is produced. The Cocoa-nut is well known to Europeans as of this character; and when picked in its young state, it is far more eatable, than when grown to the age at which it must be left, in order to bear a long voyage without injury, and at which alone, therefore it is known in this country. Its oil, as formerly stated, has now become an important article of commerce; and from its shell many useful utensils are manufactured by the Indian nations amongst whom it grows. The Date, however, though less known in this country, is not less important to one portion of the human race than the Cocoa-nut to another. A considerable part of the inhabitants of Egypt, Arabia, and Persia, subsist entirely on its fruit; and upon that which does not properly ripen, and upon the ground date-stones, the camels are fed. A single Date-palm will bear upwards of a hundred-weight of dates in a season, and sometimes more than twice that amount. They come into bearing at from six to ten years of age; and are fruitful for upwards of two hundred years. To all the uses already enumerated, the tree itself is applied, and many more might be mentioned; for so numerous are they, that, as Gibbon informs us, the native writers have celebrated in prose and verse not less than 360 different purposes. It is very interesting to observe that, over a large part of the district in which the Date Palm abounds, none of the Corn-grains can be raised, in consequence of the extreme dryness of the soil, and the want of moisture in the air. The sea-shores, the banks of rivers, and all parts of this region in which there is humidity, are exceedingly fertile; but along the verge of the desert, and in the smaller Oases or islands which are here and there met with as spots on the vast wilderness of sand, the Date-palm is the only vegetable upon which man can subsist. The more lowly vegetables are mostly of the Cactus or Euphorbia tribe, whose juices are usually too acrid to allow of their being used as food. About two hundred species of Palms are known, of which there is not a single representative in Britain. It has been estimated that the total number of species may probably amount to a thousand, many hundreds yet remaining to be discovered.

726. Allied to the Palms in the arborescent character of their stems, and in some degree, also, in the structure of their organs

of fructification, is the small order of PANDANEÆ, or *Screwpines*. Their chief peculiarities consist in the spiral arrangement of the leaves, from which the common name is derived; and in the peculiar mode in which the roots descend, to which attention has already been directed (§ 110). The flowers are diœcious or polygamous; the perianth is wholly wanting, and there is only a single stamen. The carpels are partly adherent, and each contains a single seed. A large number of flowers are clustered, as in the Palms, on a single spadix. The best-known species of this order is cultivated by the Malays and in Japan, on account of the perfume of its staminiferous flowers, which is said to be one of the richest known. The fruit is eatable; and the various parts of the tree are used, in the countries where it abounds, for the same purposes as those to which the Palms are applied.

727. Nearly allied to the Pandaneæ in regard to its organs of fructification, though very different in aspect and habit, is the order TYPHACEÆ, the *Bullrush* tribe. These are for the most part low herbaceous plants, growing in marshy places in temperate climates. The common Bullrush, however, of this country, is not well adapted for the examination of the flowering system, as this is so extremely small as not to be readily distinguished. A better illustration is the *Bur-reed* (Sparganium) some species of which may be found in most parts of the country, growing in ditches or pools, or by the banks of rivers. One of the most common is the S. ramosum, or Branching Bur-reed, which rises to the height of two or even three feet, and branches from the very ground. Its leaves (or bracts) are narrow, and shaped like a short straight sword-blade, sheathing the flower-stem at their lower part. At the extremities of the branches appear round balls of flowers, some of which are bright green, others bright yellow; the latter are most numerous, and are placed above the others. The former consist of pistilliferous, the latter of staminiferous flowers. Such an arrangement is almost universal, when the two sets of organs are disposed in different flowers on the same plant; the evident purpose being that the pollen, when set free from the anthers, shall fall naturally on the pistils. If we open

one of the yellow balls, we shall find that it consists of a cluster of separate flowers, each having a calyx composed of three long-stalked narrow sepals, surrounding six stamens, the anthers of which droop, in consequence of their weight being greater than the filaments can well support. In the pistilline flowers, the sepals are broader and shorter, being rolled round the pistil, and seated close upon the receptacle, without any stalk. The ovarium is one-celled, and contains but a single ovule, which hangs from its summit. It is surmounted by a stigma, which is partially cleft into two. Other plants of the order differ from the Bur-reed in some of these particulars; in the Bull-rush, for example, the calyx is entirely wanting, being merely replaced with a quantity of delicate black hairs; and in some species there are but three stamens. The essential character of the order is derived from the incompleteness of the flowers, and especially from the structure of the ovarium, in which no trace of the number three can at any time be detected.

728. The Typhaceæ are principally confined to the northern hemisphere, and few are found in equinoctial regions. They are not of much direct importance to man, possessing no properties which differ from those of ordinary Rushes and Sedges. Like some of these, they give an appearance of luxuriance in cold and damp situations, and afford fodder for cattle, though poor and scanty, in situations which are otherwise barren.

729. Another group of incomplete Endogens is that of ARACEÆ, the *Arum* tribe. Of these, one species is extremely common in our hedges, and is known by the name of Wake-robin, or (to children) by that of Lords and Ladies. The leaves of this group seem to offer an exception to the general parallel-veining of Endogenous leaves; rather resembling the reticulated leaves of Endogens. But this is more in appearance than in reality; since it will be observed on careful examination that the veins are *branched* (like those of the Ferns) rather then netted, and are in great measure destitute of the lateral minute branchlets uniting with each other, to which the appearance of Exogenous leaves is chiefly owing. The common species of our hedges is distinguished by the brown spots upon its leaves. Many Arums have large tuberous

underground stems; which, although acrid and even poisonous when raw, may be rendered fit for food by slicing, washing, and boiling. The flowering system of the Arums presents many points of interest. The first thing we notice, is the large spathe wrapping round a central column or spadix, on which the minute flowers are crowded. In the common British Arum it is green; but in others it presents a most beautiful variety and richness of colour. Sometimes it opens widely like an inverted bell, the mouth being a foot or more in diameter; in other instances, the summit is prolonged on one side into a long slender tail. The spadix is sometimes completely covered with flowers; but in other species (as in that of Britain) it is bare of flowers at its upper part; and it then not unfrequently assumes very strange shapes and lively colours. In the Dragon-Arum of our gardens, it is a long purple horn, projecting from a large deep purple spathe; in others it hangs down from the spathe like a slender tail; and in some cases it is enlarged into a fungus-like excrescence of disagreeable appearance.

730. If we open the spathe of the common Spotted Arum, we should find it to be whitish in its interior, and closely enveloping the lower part of the Spadix. On detaching the latter from it, we find at the bottom several tiers of round ovaria, which do not possess any proper style or stigma, but have a sort of puckering at their points, which serves the purpose of the latter. Each is one-celled, and contains two ovules growing from the side. Above these are two or three rows of abortive or undeveloped ovaria, in the form of horned pear-shaped bodies. Above these, again, there is a crowd of stamens with very short

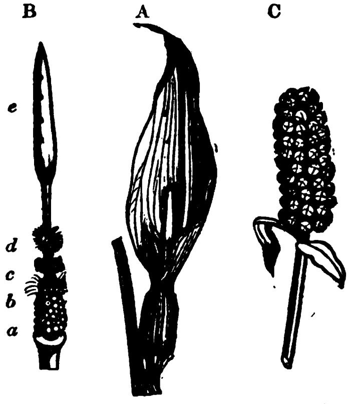


Fig. 114. Arum maculatum. A, spathe with spadix enclosed; B, spadix separated, showing *a*, ovaria, *b* and *d*, abortive ovaria, *c* staminiferous flowers, *e* naked part of the spadix; C, cluster of berries ripened on the spadix.

filaments; and these are surmounted by another cluster of abortive ovaries. Here we have a large cluster of pistilliferous and staminiferous flowers, in which the floral envelopes are entirely wanting, and in which, therefore, the separate flowers can scarcely be distinguished. Each ovarium, however, is the essential part of a pistilline flower; whilst every cluster of anthers is the essential part of a stamineous flower; so that here we have the most necessary organs of fructification reduced almost to the lowest condition in which they can exist. In a few of the tribe, however, a perianth is present consisting of four or six pieces. The fruit of the Common Arum ripens in the form of a spike of orange-coloured roundish berries, each containing but a single seed. Other species of the order differ from this in the spadix being entirely covered with flowers, in the absence of abortive ovaries, and in such other details. The peculiar character of the order is derived from the close arrangement of the flowers upon the central column or spadix, and the enclosure of the whole within a large spathe.

731. The Araceæ are very abundant in tropical countries, but become fewer in number in proportion to the distance from the equator. In cold or temperate climates they are usually herbaceous; but in tropical countries they attain a considerable size, frequently growing over large trees, to which they cling by means of aerial roots. They are for the most part acrid, and some species are extremely poisonous; one of the most remarkable effects which any of them produce is occasioned by the Dumb Cane (as it is called) a native of the West Indies and South America, which has the power, when chewed or even bitten, of causing the tongue to swell to such a degree that it cannot be moved in the mouth, at the same time occasioning very severe pain, from which recovery does not take place for some days. The cormus or rhizoma, however, possesses this acridity in a diminished degree; and as it is further dissipated by heat, they become valuable articles of food. Those of the Spotted Arum are used for this purpose in the Isle of Portland; and the starchy produce obtained from them is even sent to London under the name of Portland

Sago. In the West Indies, the tubers of another species are commonly eaten under the name of Eddoe. One of the most innocent species is that known in Britain under the name of Scented Flag-Rush (Acorus calamus), which is aquatic in its habits, as its common name implies. The rhizoma of this plant contains a considerable quantity of an aromatic essential oil, which imparts its fragrance to the mealy matter through which it is diffused; hence this is consumed in large quantities perfumers and the makers of hair-powder. It is also employed in medicine as a tonic and cordial. This order is very interesting to the Physiologist, on account of the example which it affords of the development of heat during the process of flowering (§ 412).

732. There now only remain to be considered two orders of Endogens, which bear a strong general resemblance to each other, and, indeed, are not always readily separated. One of these is that which has been spoken of as pre-eminently useful to man,—the order GRAMINEÆ, *Grass* tribe; the other, the CYPERACEÆ, or *Sedge* tribe, is almost as completely useless. They agree in the peculiar character of the floral envelopes, which constitute what is known as the *husk* or *chaff* of corn, the separate pieces or scales being termed *glumes*. These are regarded by the scientific botanist as metamorphosed bracts. The Sedges may be, for the most part, readily distinguished from Grasses, by their having stems which are solid and angular, instead of round and hollow, besides which there is no hard partition at its joints. Moreover the flowers are (with few exceptions) only protected by a solitary glume or bract. The flowers in some species all contain both sets of organs; others are monœcious, and others again are diœcious. The stamens are usually three in number, but are sometimes fewer, and occasionally more numerous. The ovarium is often surrounded by little bristles, which are perhaps the rudiments of an undeveloped perianth, as no other traces of calyx or corolla can be found; it contains one seed; and its style is usually single, dividing at the top into two or three stigmata. The fruit, when ripe, is a hard three-cornered nut, indicating the original formation of the ovarium from three carpels. The seed

presents a remarkable difference from that of Grasses; for the embryo is a minute roundish undivided body, lying buried within the albumen, at its lower extremity, instead of being placed on its side, as it will be presently shown to be in the Grasses (§ 735).

733. To the Sedge tribe belong many of the plants which are popularly considered as Rushes, and which are employed in the manufacture of candles, mats, and chairs; amongst the most remarkable of the British species is the *Club Rush*, which sometimes grows to the height of nine feet. This order is perhaps more widely distributed than any other except the Grasses. Several of its members are found in marshes, ditches, and by running streams; others flourish in meadows and on heaths; others in groves and forests, others on the loose sand of the sea-shore, others on almost naked rocks, and others on the barren sides and summits of mountains. In the most northern climates, their number equals that of the Gramineæ; but as we approach the Equator, the proportion very much diminishes, both by the increase of the Grasses, and the diminution of the Cyperaceæ. Some of this tribe have a large rhizoma, which may be employed for the same purposes as that of the edible Araceæ. One of the most interesting plants belonging to the group is the *Papyrus*, famous as having afforded to the ancients the chief of their materials for writing, from which our word *paper* is derived, although the nature of the *thing* is entirely different. The former uses of this plant, which is a native of Ethiopia and Egypt, were many. The roots were chewed for the pleasant juice they yield, and the Egyptians used to roast their stalks and eat the soft pulpy matter they contain. The stalks afforded materials for ropes and cables; and the leaves were employed, as they are at the present time, to make the small boats, in which the inhabitants of the banks of the Nile venture upon its waters. Although the Papyrus generally prefers stagnant pools and lakes, yet it will grow in rapidly-running streams; and in such circumstances it is stated always to oppose one angle of its three-cornered stem to the current, so as to break it with the least force. The material used for writing on is

commonly said to have been prepared from the leaves of the plant; this is not the case, as it was obtained by separating the thin plates of cellular tissue which lie just beneath the exterior of the stem, those nearest the centre being esteemed the best. These were then trimmed at their edges, so as to meet equally, and laid side by side on a hard flat table; and other pieces, similarly cut, were laid across them at right angles. They thus formed a sheet of many pieces, which required a means of adhesion to become one united substance when closely pressed together. This union was effected simply by sprinkling them with water; since they themselves contain a sufficient amount of gummy and saccharine matter to adhere when this is dissolved by the water. The ancient Egyptians made sheets of a prodigious length; the celebrated traveller Belzoni had one whicn was 23 feet long by 1½ broad. From Egypt it was long exported in large quantities, especially to Greece and Rome; and was the only material employed for writings destined to be preserved, until the invention of parchment, which took place about 250 B. C. This for a long time, however, did not supersede papyrus, the demand for which at Rome continued for a long time after the Christian era. The supply was interrupted by the invasion of Egypt by the Saracens, in the seventh century; and as parchment was then generally substituted for it, the demand no longer existed. The latest notice of its regular manufacture brings it down to the eleventh century. The quantity made by the ancient Egyptians must have been enormous, judging by the number of rolls frequently found in the tombs, and in the mummy-cases. In the Museum of Naples, there are nearly 1800 MSS. of this description, which have been dug out of a small part of the city of Herculaneum; whence the number that must have existed in the Roman Empire at that time may be in some degree guessed at. The paper produced from this substance, however,—so far as can be judged of by the specimens which have been preserved to us, and by the attempts which have been made to revive the manufacture, was inferior to the paper we now produce from linen and cotton rags, in every respect save durability.

734. The general appearance of the ordinary GRAMINEÆ or *Grasses*, is familiar to every one; their hollow, cylindrical and jointed stems, with their long narrow leaves, distinguish them readily from all other plants. But we are not so commonly in the habit of associating, with the humble kinds with which we are familiar, the tall Sugar Canes and gigantic Bamboos of tropical climates; yet these are only Grasses on a larger scale, agreeing with our own in every essential particular, and differing mostly in size. The amount of variety in subordinate characters among the several genera and species of this large order, is very considerable; and it will be only attempted here to give a sketch of what may be regarded as the typical structure of the organs of fructification. It will be found convenient to begin with the inner rather than with the outer part of the flower. In the Sugar-Cane, for example, on separating the parts of the flower, we observe the centre occupied by an ovarium, having two styles surmounted by hairy stigmas; and round this are disposed three stamens, with large anthers supported on very slender filaments. The number of these varies in different tribes; but they are in

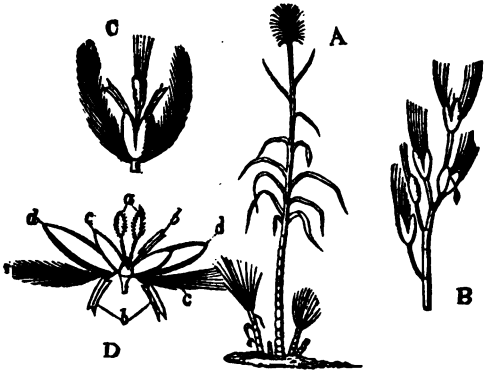


Fig. 115. Sugar-Cane with its flowers. A, whole plant; B, cluster of flowers enclosed in glumes; C, single flower enlarged, with glumes separated; D, flower opened, showing *a*, stigmas, *b b*, stamens, *c*, scales, *d*, paleæ.

general three; though sometimes six (as in Rice), and occasionally only one or two, are developed. In some Grasses, the two sets of organs are disposed in distinct flowers, sometimes on the same plant, and sometimes in different ones. The envelopes of these consist of several wrappings of little scales, which have received various designations. The inner pair, which are usually very small and thin, closely sheathing the ovary, are termed *Scales;* externally to these, surrounding the stamens, are two others which are called *Paleæ.* These again are enclosed between another pair, which are the *glumes.* The midrib of one palea or one glume is often prolonged into a bristle-like termination, which is called an *awn.* Where the flowers are arranged in distinct clusters, each of these is usually sheathed in a large scale arising from the base of its

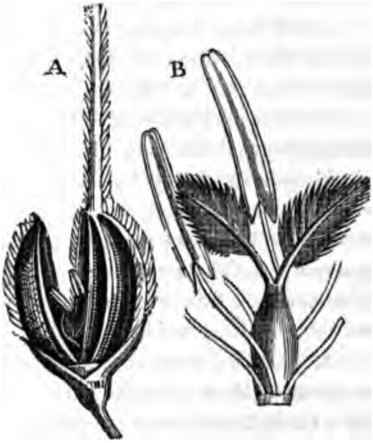


Fig. 116. Flower of Rice enlarged; A, showing paleæ and awn; B, ovarium of stigmas, with two of the six stamens.

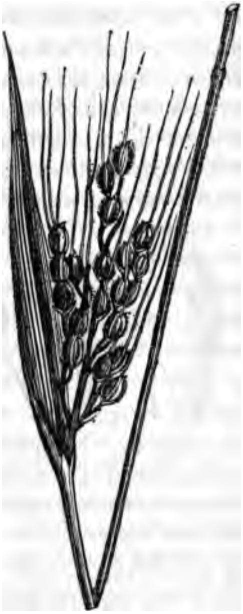


Fig. 117. A cluster or panicle of flowers of the Rice Plant, with its sheathing bract or glume.

flower stalk, as is shown in the Rice; this also is termed a glume. Of all these parts, the interior *scales* are the only ones which bear any resemblance to the calyx or corolla of more perfect flowers; the remainder are to be considered as bracts.

735. If the ovary be cut across, nothing but a kind of pulp will be found within it; this substance then fills the young ovule, which entirely occupies the cavity of the ovarium; and its own envelopes and the walls of the ovarium grow together, in such a manner as to be scarcely distinguishable. When ripened, however, the ovary becomes hard; and its own walls and the membranes of the seed having coalesced still more closely, all trace of the originally distinct seed vessel is lost. Such a seed, which appears destitute of an external casing, but which has really been developed within one, is properly termed a grain (See § 504). The great mass of the seed consists of the separate albumen; and the embryo itself is very minute, and not easily discovered by an unpractised Botanist. If the grain be laid upon its flat face, so that the convex side is uppermost, a minute oval depression will be seen towards the narrowest end; and if the seed-coat be carefully removed, a little oval body will be found lying half imbedded in the albumen. If this be divided perpendicularly with a sharp knife, it will be found to consist of a thickish scale, which is the single cotyledon; and upon this lies a little conical body, composed of several minute sheaths fitted one over the other, which is the plumula; whilst at the opposite extremity will be found the radicle, or rudiment of the root. When the radicle first begins to grow, the cotyledon swells a little, and attaches itself firmly, by the whole of its absorbent surface, to the albumen; and this, as it is gradually changed in the process of germination, is absorbed by that surface, and supplied by it to the plumula and radicle, until they have attained

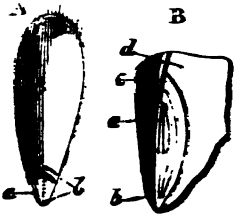


Fig. 118. Seed of Grass; A, external view, showing a, depression at the end, and b, position of embryo; B, section, showing the plumula a, the radicle b, and the cotyledon c, the whole embryo being on the outside of the albumen d.

sufficient development to absorb and prepare nutriment for themselves, by which time the store laid up in the albumen is exhausted. This provision enables the germination of the seed to take place with much greater rapidity than we usually find in those which have a separate albumen; for in the latter, the surface by which the young plant absorbs from it is much smaller, the cotyledon being sent upwards around the young stem.

736. In general, the true stems of Grasses are hidden, like those of several other Endogenous tribes, as well as of Ferns, beneath the earth; and the stalks which bear the organs of fructification are not to be considered in this light. In the *Bamboos* of tropical climates, however, the true stems elevate themselves into the air, sometimes to the height of 50 or 60 or even 100 feet, sending out lateral branches. The internal structure of the rhizoma of the Grasses is strictly Endogenous; as is that of the *culms* or hollow stems, if examined at the period of their first development; and their subsequent hollowness results merely from the development of the fibrous portion of their structure, which forms the exterior, faster than the cellular parenchyma increases to fill it. This form of the stem is a very beautiful illustration of the mode in which the greatest possible strength may be obtained with the least expenditure of material. Some of the Grasses have, instead of a rhizoma or an upright stem, a long creeping stem, which runs near or upon the surface, sending down roots into the soil, and developing leaf and flower-buds at intervals. This tendency has already been adverted to as very troublesome in the Couch-grass *(Triticum repens)*; but is of great service to man in a grass termed the Sand-Reed *(Arundo arenaria)* and others, which can vegetate amidst dry and drifting sand, and are hence employed to give firmness to embankments, which they pierce with an entangled web of living structure, that offers a resistance rarely overcome by the force of storms, and is renewed as fast as it is destroyed. Such grasses do not increase so much by seeds as by the multiplication of buds; and hence they are commonly spoken of as *viviparous;* cattle will no. eat them, and hence they are providentially adapted to escape that mode of destruction;

but when they have been uprooted by the thoughtlessness or ignorance of man, the most serious evils have arisen. In Scotland, for example, large tracts of once fertile country have been rendered barren, by the encroachment of sand hills, which have given them the desert-like aspect of Egyptian plains; and this encroachment has resulted from the wanton destruction of the *mat grasses*, which were pulled up by the country people for fuel, to such an extent, that an Act of Parliament was passed about an hundred years ago, rendering it punishable to do so.

737. Less need be here said of the uses of this tribe to man, since they are more obvious than those of most others, especially to the inhabitants of temperate climates. When it is considered that all the Wheat, Barley, Oats, Rye, and other Corn-grains used as food by man,—as also Rice and Maize or Indian Corn, which support an even larger number than the former,—the Sugar, which is now become not only an article of luxury to him but of necessity,—and the various grasses that form the staple food of nearly all the animals upon which he relies for the supply of his appetite and for assistance in his labours,—it will be at once seen that no single tribe can be compared with the Gramineæ in importance to him. We have had to notice other tribes and even particular species, which are of the most important benefit in certain situations; such are the Date and the Cocoa Nut. But these are valuable just because the Grasses, which are otherwise universal in their distribution, are prevented by peculiarities of climate or other causes, from flourishing in those particular spots. In all but the very coldest parts of Europe, we find some of the corn-grains affording the principal supplies of food;—barley and oats in the north, rye in latitudes a little more southern, and then wheat. In the Southern parts of Europe, rice and maize come into ordinary cultivation; and the use of these extends throughout the tropics.

738. The various provisions for the natural propagation of these important vegetables are extremely interesting. The animals which browse upon them usually prefer the foliage, leaving the flower-stalks to ripen their seed; or, if they destroy both, the plant spreads by offsets from the underground stems. Even if they

be trodden down, they are not destroyed; for buds are developed from the several nodes of the stem, which thus multiply the plant. It is on exposed downs and barren places, where the heat is insufficient to ripen the seeds, and where there is no germination, that we find the tendency to multiply by buds most remarkable.

739. It may give some idea of the enormous amount of subsistence afforded by the Grasses, to state that, some years ago, when the population of Britain was much less than it is at present, it was calculated, after a laborious series of investigations, that 416 *million bushels* of corn are annually consumed in Britain, besides 100,000 bags of Rice, and 200,000 tons of sugar. It has been estimated that there are upwards of a million of horses employed in Britain in different ways, each requiring as much vegetable food as would support eight men; the value of their pasturage, therefore, must be fully one-third of that from which the quantity of corn just mentioned is produced. Further, it has been stated that, not computing pork, bacon, or poultry, upwards of 150 million pounds of meat are annually consumed in London alone; and this amount should probably be multiplied by at least ten, to represent the consumption of the country in general. Again, it has been calculated that the value of the butter and cheese annually made in Britain is not less than £5,000,000. These and many other animal products are almost entirely obtained from the plants of this order; which, however, insignificant in appearance, have been obviously adapted, in a peculiar manner, by an All-bountiful Creator to the varied wants of his human offspring.

740. In speaking of the uses of the Grasses to man, that of the Bamboos should not be forgotten. To the Indian Savage they afford almost all that he wants, except the food which he derives from his rice or his maize. "With their lightest shoots he makes his arrows, the fibres of the wood form bow-strings, and from the larger stems he fabricates a bow; a long and slender shoot affords him a lance-shaft, and he finds its hardened point a natural head for the weapon. With the hardened stems he builds the walls and roof of his house; its leaves afford him an impene-

trable thatch; split into narrow strips it gives him the material for weaving his floor-mats, and other articles of domestic convenience; its fibre furnishes him with twine, and its leaves provide him with paper, when he becomes sensible of the utility of such a material. Would he commit himself to the waves, the stems form the hull of his boat, which by a few skins stretched over it is rendered water-tight; they also give him masts, and then slips of wood become cordage, or are woven into sails." Even in more civilized countries, such as China, India, and Japan, they are applied to a great number of useful purposes. Water-pipes are often made of them; and they are used in the construction of fences, in building houses and boats, and in the manufacture of various articles of furniture. Short sections of the stems, cut so as to include the nodal partition, are employed for a great variety of useful purposes; the small ones serve as cups; and the large ones (which are sometimes more than a foot in diameter) for tubs and boxes.

741. The following table exhibits, in a simple form, the characters by which the foregoing orders may be distinguished from each other, and from other tribes of Endogens which have not been here noticed.

I. FLOWERS COMPLETE.

A. Ovary *inferior*.
a, Veins of leaves diverging from the midrib.
α, Anthers 2-celled.
Stamens 3 .. .. .. *Scitamineæ*
Stamens 6 .. .. .. *Musaceæ*
β, Anthers 1-celled .. .. .. *Marantaceæ*
b, Veins of leaves parallel with the midrib.
α, Flowers gynandrous .. .. *Orchideæ*
β, Flowers not gynandrous.
Anthers turned outwards .. *Iridaceæ*
Anthers turned inwards.
Stamens 6 .. .. .. *Amaryllideæ*
Stamens more than 6 .. *Hydrocharaceæ*
B. *Ovary superior.*
a, Sepals resembling petals.
α, Flowers on a Spadix .. .. *Palmaceæ*
β, Flowers not on a Spadix.
Anthers turned inwards .. *Liliaceæ*
Anthers turned outwards .. *Colchicaceæ*
b, Sepals green or scaly.
α, Carpels separate . .. .. *Alismaceæ*
β, Carpels consolidated .. .. *Juncaceæ*

II. FLOWERS INCOMPLETE.

A. Flowers glumaceous.
a, Stems hollow .. .. *Gramineæ*
b, Stems solid .. .. *Cyperaceæ*
B. Flowers naked, or with a few verticillate scales.
a, Flowers on a Spadix.
α, Anthers on weak filaments .. *Typhaceæ*
β, Anthers sessile .. .. .. *Araceæ*
b, Flowers not on a Spadix.
α, Ovules pendulous .. .. .. *Naiadeæ*
β, Ovules erect .. .. .. *Lemnaceæ*

CONTENTS.

PAGE.
Introductory Chapter.—General Principles of Classification.—Principles of *Natural* and *Artificial* Arrangements.—Linnæan System.—De Candolle's System 296

Class I. EXOGENS.

Sub-Class I. Thalamifloræ.

Order Ranunculaceæ, or *Crow-foot* Tribe,—Anemony, Hellebore, Monkshood, &c. 331
—— Magnoliaceæ, or *Magnolia* Tribe 338
—— Anonaceæ, or *Custard-Apple* Tribe 340
—— Menispermaceæ, or *Cocculus* Tribe 340
—— Berberideæ, or *Berberry* Tribe 341
—— Nymphaceæ, or *Water-Lily* Tribe,—Victoria regalis, &c. .. 341
—— Fumariaceæ, or *Fumitory* Tribe 343
—— Papaveraceæ, or *Poppy* Tribe,—Celandine, &c.—Opium .. 346
—— Cruciferæ, or *Turnip* Tribe,—Cabbage, Mustard, Stock, Scurvy-grass, &c. 350
—— Cistaceæ, or *Rock-Rose* Tribe 354
—— Violaceæ, or *Violet* Tribe,—Pansy, &c. 356
—— Droseraceæ, or *Sun-dew* Tribe 357
—— Caryophylleæ, or *Chick-weed* Tribe,—Pink, Carnation, Ragged-Robin, &c. 358
—— Linaceæ, or *Flax* Tribe 360
—— Malvaceæ, or *Mallow* Tribe Cotton 364
—— Bombaceæ, or *Silk-Cotton* Tribe,—Baobab 368

PAGE.

Order Bromaceæ, or *Cacao* Tribe 370
—— Tiliaceæ, or *Linden* Tribe,—Lime 372
—— Dipterocarpeæ, or *Camphor-tree* Tribe 374
—— Camelliaceæ, or *Camellia* Tribe,—Tea 374
—— Aurantiaceæ, or *Orange* Tribe,—Lemon, Shaddock, &c. .. 378
—— Ampelideæ, or *Grape* Tribe,—Virginian Creeper, Zante Currant, &c. 382
—— Geraniaceæ, or *Geranium* Tribe,—Cranesbill, Herb-Robert 387
—— Tropæoleæ, or *Sturtion* Tribe 390
—— Balsamineæ, or *Balsam* Tribe 391
—— Oxalideæ, or *Wood-Sorrel* Tribe 392
—— Rutaceæ, or *Rue* Tribe,—Fraxinella 393
Analytical Table 396

Sub-Class II. CALICIFLORÆ.

Order Celastrineæ, or *Holly* Tribe,—Brazilian Tea, Spindle-tree 398
—— Rhamneæ, or *Buckthorn* Tribe,—Jujube, Lotus 399
—— Terebintaceæ, or *Terebinth* Tribe,—Cashew-nut, Mango, Gum Mastic 402
—— Leguminosæ, or *Pea* Tribe,—Beans, Clover, Senna, Tamarind, Mimosa, &c. 403
—— Rosaceæ, or *Rose* Tribe,—Apple, Strawberry, Raspberry, Almond, Medlar, &c. 407
—— Rhizophoreæ, or *Mangrove* Tribe 410
—— Onagrariaceæ, or *Evening-Primrose* Tribe,—Willow-Herb, Fuchsia, &c. 413
—— Myrtaceæ, or *Myrtle* Tribe,—Clove, Pomegranate, &c .. 414
—— Cucurbitaceæ, or *Gourd* Tribe,—Melon, Cucumber, Calabash, &c. 416
—— Passifloreæ, or *Passion-flower* Tribe,—Grenadilla, &c. .. 418
—— Crassulaceæ, or *Houseleek* Tribe,—Sedum, &c. 421
—— Cacteæ, or *Prickly-Pear* Tribe,—Indian Fig, Night-flowering Cereus, &c. 422
—— Grossulariæ, or *Gooseberry* Tribe,—Currant, &c. 425
—— Saxifrageæ, or *Saxifrage* Tribe,—London Pride, Hydrangea, &c. 427
—— Umbelliferæ, or *Umbelliferous* Plants,—Carrot, Parsnep, Celery, Hemlock, Parsley, &c. 429
—— Loranthaceæ, or *Misseltoe* Tribe 432

PAGE.
Order Caprifoliaceæ, or *Honeysuckle* Tribe,—Elder, Guelder Rose, Laurestinus, &c. 433
—— Rubiaceæ, or *Madder* Tribe,—Coffee, Peruvian Bark, &c.. 433
—— Compositæ, or *Composite* Plants,—Daisy, Sun-flower, Asters, Thistle, Dahlia, &c. 437
—— Campanulaceæ, or *Harebell* Tribe 444
—— Lobeliaceæ, or *Lobelia* Tribe 446
—— Ericineæ, or *Heath* Tribe,—Rhododendron, Kalmia, Azalea, &c. 447
Analytical Table 449

Sub-Class III. COROLLIFLORÆ.

Order Primulaceæ, or *Primrose* Tribe,—Primrose, Cowslip, Polyanthus, &c. 451
—— Oleaceæ, or *Olive* Tribe,—Ash, Lilac, Privet, &c. 452
—— Jasmineæ, or *Jessamine* Tribe 454
—— Gentianeæ, or *Gentian* Tribe,—Centaury 454
—— Convolvulaceæ, or *Bindweed* Tribe,—Jalap, Scammony, Dodder, &c. 455
—— Labiatæ, or *Labiate* Plants,—Mint, Sage, Rosemary, &c. .. 457
—— Solaneæ, or *Nightshade* Tribe,—Henbane, Tobacco, Potatoe, &c. 453
—— Scrophularineæ, or *Foxglove* Tribe,—Snapdragon, Figwort, Speedwell, &c. 469
Analytical Table 465

Sub-Class IV. MONOCHLAMYDEÆ.

Order Chenopodeæ, or *Goosefoot* Tribe,—Spinage, Beet, Rhubarb, Buck-wheat, &c. 466
—— Laurineæ, or *Laurel* Tribe,—Cinnamon, Nutmeg, &c. .. 468
—— Euphorbiaceæ, or *Spurge* Tribe,—Castor-oil, Cassava, Manchinell, &c. 471
—— Urticeæ, or *Nettle* Tribe,—Fig, Bread-fruit, Hemp, Mulberry, Hop, &c. 473
—— Piperaceæ, or *Pepper* Tribe 477
—— Amentaceæ, or *Catkin* Tribe,—Oak, Beech, Hazel, Elm, Poplar, &c. 478
—— Coniferæ, or *Pine* Tribe,—Fir, Larch, Cedar, &c. 481

CLASS II. ENDOGENS.

PAGE.
Order Hydrocharideæ, or *Frog-bit* Tribe,—Water-soldier, Vallisneria 484
—— Alismaceæ, or *Water Plantain Tribe*,—Arrow-head, &c. .. 486
—— Lemnaceæ, or *Duckweed* Tribe 489
—— Naiadeæ, or *Pondweed* Tribe,—Grass-wrack, &c. 490
—— Orchideæ, or *Orchis* Tribe,—Vanilla, Salep, &c. 491
—— Scitamineæ or *Ginger* Tribe,—Turmeric, Cardamom, &c. 497
—— Marantaceæ, or *Arrow-root* Tribe 498
—— Musaceæ, or *Plantain* Tribe,—Banana 499
—— Iridaceæ, or *Iris* Tribe,—Corn-flag, Crocus, Saffron 502
—— Amaryllideæ, or *Narcissus* Tribe 504
—— Liliaceæ, or *Lily* Tribe,—Hyacinth, Onion, Asphodel, Pine-Apple, &c. 505
—— Palmaceæ, or *Palm* Tribe,—Date, Cocoa-nut, &c. 516
—— Pandaneæ, or *Screwpine* Tribe 522
—— Typhaceæ, or *Bullrush* Tribe 523
—— Araceæ, or *Arum* Tribe,—Wake-robin, Eddoe, &c. 524
—— Cyperaceæ, or *Sedge* Tribe,—Club-rush, Papyrus, &c. .. 527
—— Gramineæ, or *Grass* Tribe,—Corn, Rice, Sugar-cane, Bamboo, &c. 530
Analytical Table 537

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From the Eclectic Review, August, 1841.

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